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HISTORICAL STUDY OF A PROGRAM OF  
SYSTEMATIC OBTURATOR REDUCTION  
FOR PALATAL INCOMPETENCE

By

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B.A., University of Montana, 1976


Presented in partial fulfillment of the requirements for the degree of  
Master of Communication Science and Disorders

UNIVERSITY OF MONTANA

1980

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## PREFACE

Management of the cleft palate population is a subject of considerable debate today. The obturator reduction program is one such controversial technique used at the University of Oregon Medical School. This paper focuses on that program and its long-term influence on 54 patients with velopharyngeal insufficiency. The 54 cases were evaluated in terms of the type of physical problems involved, treatment variables, and status of each patient at the end of the program. The results are discussed and summarized in tables.

## ACKNOWLEDGMENTS

I wish to express my sincere appreciation to C. Donald Nelson, Ph.D. and Robert Blakeley, Ph.D. for their support and willingness to share their knowledge and give advice and assistance throughout this project. I would also like to express my appreciation to the staff of the Department of Communication Science and Disorders at the University of Montana who encouraged me to complete this project.



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## Chapter 1

### THE VELOPHARYNGEAL MECHANISM

The velopharyngeal mechanism's muscles and the individual actions of these muscles are fairly well-understood. Actual patterns can and have been studied in normal and insufficient cases. A main concern is the effect of these muscle patterns on the speech of patients with an insufficient velopharyngeal mechanism.

The movement of the velopharyngeal mechanism has been described as a sphincter activity that involves the velum and pharynx. The velum and pharynx are composed of eight muscles. Five of these muscles are attached to the velum: levator veli palatini, palatoglossus, palatopharyngeus, constrictor pharyngis superior, and tensor veli palatini. One muscle, the uvula, is intrinsic to the velum. Two muscles, the salpingopharyngeus and stylopharyngeus lie in the lateral wall of the pharynx.

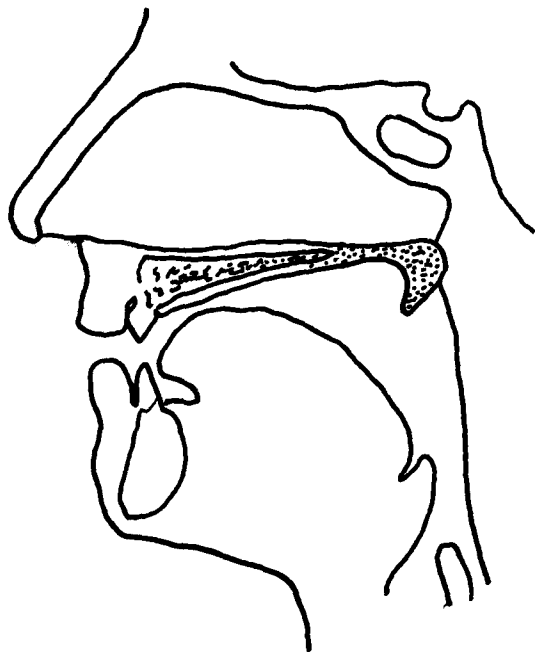
During speech, the levator veli palatini elevates the soft palate against the posterior pharyngeal wall thus directing the air stream through the mouth. The pharyngis superior may also aid in this oralization by producing an inward movement of the pharyngeal wall and constricting the pharyngeal wall around the soft palate. The palatoglossus muscle lowers the soft palate for nasal sounds by pulling the velum downward and forward.

The efficiency in which the muscles of the velopharyngeal

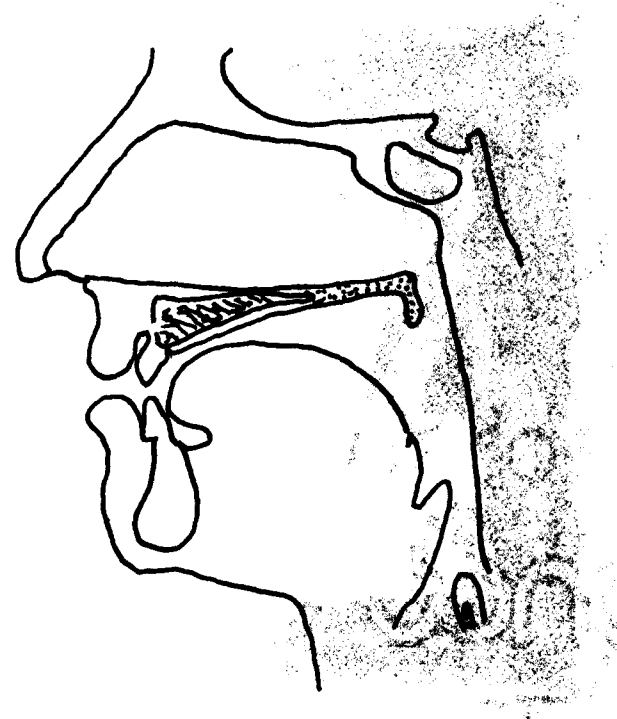
mechanism direct oral versus nasal air flow controls hypernasal or hyponasal speech. When the velopharyngeal mechanism is inadequate, speech is perceived as having a nasal quality. The insufficient closure with the oral and nasal pharynx may produce nasal emission or hypernasal speech. Hyponasal quality occurs when the opening between the nasopharynx and the oropharynx does not occur sufficiently on the nasal consonants (Fig. 1).

For the patient with velopharyngeal insufficiency, a number of variables have been found to influence speech production. There appears to be a dynamic relationship between the muscle patterns, auditory feedback, speech perception, the serial order of speech, and tactile kinesthetic feedback. It was thought in the past that the size of the velopharyngeal opening was directly related to the severity of nasal speech. Present research indicates that this is not always true. For example, some patients are able to make effective closure during isolated sounds, single words, and/or nonspeech tasks such as holding air in the oral cavity. These same patients may be unable to maintain efficient closure during conversational speech. It appears that these patients can assume the valving position, but are unable to use an effective pattern of closure during speech. This more complex valving action is influenced by the phonetic context, the level of oral/nasal impediment, and pattern of closure (Shelton, et al., 1964).

In young patients it is critical to understand the velopharyngeal mechanism in terms of the dynamic relationship between muscle structure and the neurological patterns which control these structures



a. Normal palatal-pharyngeal closure



b. Abnormal palatal-pharyngeal closure with palatal insufficiency

Figure 1. Normal and Abnormal Palatal-pharyngeal Closures

Source:

R. Blakeley, 1979, personal conversations at the University of Oregon Medical School, Oregon Medical School, Portland, Oregon (sketches supplied in a handout).

and produce speech. Inappropriate compensatory patterns may be more effectively treated in this way. Changes in muscle structure, due to muscle growth and development or surgical intervention may require appropriate changes in learned speech patterns. If appropriate changes are not made at early stages, later correction may be considerably more difficult.

## Chapter 2

### A REVIEW OF INTERVENTION TECHNIQUES

The needs of cleft palate patients are diverse in the first two to three years of life. These include problems with life sustaining functions such as breathing and eating. Primary surgery of the cleft is normally performed to solve these basic health threats. Management procedures are then directed toward speech development and cosmetic appearance. Reliable intervention techniques are required for timely treatment. Treatment should take place and be effective during the critical learning period for speech. Early treatment should also help avoid the negative social impacts of abnormal speech which can complicate treatment. Numerous management techniques have been reported in the literature. These can be broadly classified into speech therapy, muscle stimulation, prosthesis, and surgery.

#### Speech Therapy

Many patients with inadequate velopharyngeal closure develop an inappropriate compensatory articulation. For some, these articulation errors continue when adequate velopharyngeal closure is developed. The goal of articulation therapy is dependent upon the quality of articulation skills used by a client and the ability of the client to make effective velopharyngeal closure during speech,

thus it is critical that an assessment distinguish the error types.

Speech errors can be divided into five categories.

1. Errors not related to cleft palate, such as developmental errors.

2. Habitual errors--those related at one time to cleft palate but now fixed and not related to current organic deficiency. This category includes hypernasality and nasal emission.

3. Errors due to dental malocclusion or deficiency.

4. Errors of articulation--those directly related to organic deficiency such as velopharyngeal inadequacy. Errors of hypernasality and nasal emission could also be included in this category.

5. Errors that combine features of the above categories such as articulation skills, a combination of habit and organic deficiency (Blakeley, 1979).

Intensive training is necessary to modify severe articulation difficulties and to develop new patterns. Management of velopharyngeal insufficiency clearly facilitates voice and articulation mastery; however, speech therapy alone is not sufficient when the errors are contingent on velopharyngeal insufficiency. This physical problem may be treated by a variety of surgical or prosthetic techniques including the obturator. In any case, a program in conjunction with speech therapy is essential to the management of cleft palate patients. This researcher concludes that a timely program involving appropriate prosthesis and/or surgery combined with speech therapy is most effective.



### Muscle Stimulation

Cole<sup>1</sup> discussed various rationales in the literature that are used to justify programs of muscle training. The basic rationale is "based on the fact that the sense of position or of movement of oropharyngeal structures can be increased with appropriate stimulation" (p. 251). There is, in reality, scant evidence that a speech pathologist can appreciably increase a patient's conscious awareness of velar position in space. The posterior portion of the palatopharyngeal region is poorly invested with extra or cutaneous receptors believed to mediate tactile and kinesthetic sensory information. Training to increase awareness of palatopharyngeal activity yields little more than a recognition of general tension in the region; such cognizance is typically evident only during nonspeech activities.

Several factors appear to predict the efficiency of muscle training. Inconsistent hypernasality and nasal air escape may indicate borderline velopharyngeal adequacy. Ability to blow against resistance may indicate that the palate is capable of contacting the pharyngeal wall. The muscle training can be direct or indirect, such as speech drill work and/or blowing and whistling activities. Direct stimulation of the velopharyngeal region has taken several forms ranging from the use of cotton swabs, application of electrical current, and inflatable balloons. While the results are contradictory, evidence suggests that

---

<sup>1</sup>R. Cole, 1971, "Direct Muscle Training for the Improvement of Velopharyngeal Function," *Communication Disorders Related to Cleft Lips and Palate*, ed. K. Bzoch (Boston: Little, Brown and Company).

direct stimulation regardless of form or intensity has little or no effect upon the amount of discernable movement evidenced during speech (Morris and Lloyd, 1963).

### Prosthesis

There are four types of prosthetic intervention: palatal lift, palatal stimulators, Lubit Palatal Exerciser, and the obturator. The latter is discussed in Chapter 3.

#### Palatal Lift

The palatal lift prosthesis is frequently used with noncleft patients who have hypernasal voice quality, soft palate of adequate length, and immobile soft palate musculature. This is often caused by a neuromuscular deficit, velar paralysis, central nervous system dysfunction, or muscle metabolism pathology. This prosthesis has been found to be less successful in patients with involvement of the oropharyngeal muscles and those with a velopharyngeal space greater than two or three millimeters (Dalston, 1977; Posnick, 1977).

The palatal lift has been used as a diagnostic aid for predicting the potential success of pharyngeal flaps. It is thought to stimulate lateral and posterior musculature. Studies done of palatal lifts (Hulley, et al., 1973; Kipfmueller and Laney, 1972) indicated that it can reduce errors of articulation and the size of the lumen, thereby reducing nasality and increasing intelligibility of speech.

The objective of the palatal lift is to elevate the soft

palate to its maximal position (close contact with the posterior pharyngeal wall) during speech and deglutition. For patients with palatopharyngeal insufficiency, it may be used in combination with obturators to stimulate and develop musculature. It differs from the obturator in that the velar section is broader and is designed to displace the soft palate to a superior position. Additions are made to the superior height of the lift section to elevate and stimulate the soft palate and increase its activity. It has been used as a permanent or temporary prosthesis that is reported to be most successful when used immediately following paralysis to prevent muscle atrophy. The success of the palatal lift depends on gradual velar elevation and early treatment. Like many of the other prosthetic devices it is considered to be most effective when used with speech therapy (Kipfmüller and Laney, 1972; Mazaheri and Mazaheri, 1976).

#### Palatal Stimulators

Palatal stimulators, described by Adisman (1975), are similar to obturators except that they "include a cast metal ring circumscribing the uvula" (p. 327). The stimulator has been used with congenital palatal incompetent clients who have an anatomically normal soft palate that demonstrates little or no mobility. It doesn't produce obturation, rather it produces physical and mechanical resistance for the soft palate muscles to function against and, thus, initiates a stimulus for increased activity of the inadequately contracting muscle fiber.

### Lubit Palatal Exerciser

An appliance, the Lubit Palatal Exerciser discussed by Lubit and Larsen (1971), was utilized to improve velopharyngeal competence. The appliance consisted of an inflatable pharyngeal bulb within a supportive positioning plate. This device was reported to be capable of

producing exercises of the oropharyngeal tissue which can result in stretching the soft palate and improving its neuromuscular control and increasing the range of the forward and mesial movements of the pharyngeal musculature (p. 329).

When used in conjunction with articulation therapy, the authors documented improvement of velopharyngeal closure and speech.

### Surgery

Although the condition of cleft palate has been known since earliest times, the history of operative procedures was not well-documented until the nineteenth century. Early operations were concerned with the closure of tissue and structures; it was not until the early 1900s that surgery became more concerned with the resulting speech of a patient.

The timing and type of surgical procedure depends upon the surgeon and type of cleft. Closure of the lip is generally done by the time a child is three months or weighs ten pounds. Repair of unilateral and bilateral clefts of the lip are performed in one or two stages using variations of the procedures advocated by Veau (Schwartz, 1975).

The optimal time for primary surgery on hard and soft palates is controversial. The disagreement about optimal closure time appears

to center around the surgical effect on normal development of the maxillary arch, hearing, and resulting optimal velopharyngeal closure. Research of the cleft palate patient continues; the ideal treatment and optimal age for surgery are still being questioned. Variables affecting time and success include kind and quality of surgical intervention, a patient's adaptability, type and extent of cleft(s), and secondary associated problems of the patient, i.e., physical and psychosocial (Lindsay, et al. 1975).

Secondary surgical procedures, such as the pharyngeal flap, have been widely used to correct or eliminate hypernasal speech in patients with velopharyngeal insufficiency. Secondary procedures do not increase movement in the velopharyngeal mechanism. They position structures to make optimal use of movements available to a speaker. The pharyngeal flap procedure is most common and is considered the most reliable and successful. The pharyngeal flap provides a substitute method for normal closure in the nasopharynx. In this operation tissue at the back of the throat is attached to the palate to diminish excessive air flow through the nose.

Other types of procedures are used in special cases or when preferred by a surgeon. The most common are (1) Dorrance push-back operation which lengthens a short palate, (2) the Wordill procedure which builds a buldge at the level of the passavants ridge and reduces the increased dimension of the nasopharynx, (3) pharyngoplasty which attempts to narrow the pharynx and bring the pharyngeal wall forward, and (4) muscle transplant, generally from the lateral wall to the posterior pharyngeal wall.

The pharyngeal flap was first performed by Schoeborn in 1847. Numerous failures caused it to be abandoned until the twentieth century. It was reintroduced to Germany in 1924 and to the United States in 1930. A recent study called the Bratislava Project (Morris, 1978), found acceptable speech in 86.16 percent of the pharyngeal flap patients. It has generally been reported that 80-90 percent of the patients improved following secondary surgical procedures. One needs to be cautious, however, in the interpretation of success rates. The literature from 1948 to 1968 on speech after primary surgery noted improvement in 32-94 percent of patients (Morris, 1978).

Success rates vary widely between studies and, by implication, between surgeons. The variation in success rates found in cross studies may be due to inconsistent diagnostic procedure to adequately analyze phonatory resonance and articulation. Variability in speech success rates for various programs may also be due to the time after surgery in which the speech was analyzed.

A study by Kenneth Bzoch (1964) indicated that many patients do not have a noticeable change in resonance for up to one year. Bzoch suggested that this time was needed for the muscles to increase their activity. For example, some surgeons overcorrect for velar pharyngeal insufficiency by constructing a superiorly based epithelialized flap whose lateral openings through the nasopharynx are three to four millimeters in diameter. This produces hyponasality in a number of patients; for some it may be advantageous. A short duration of hyponasality may train the patients to build oral pressure and correctly produce plosives and fricatives, thereby reducing gross

substitutional error patterns. With time, shrinkage should occur. This eliminates the hyponasal speech and allows a normal speech pattern. If the shrinkage does not occur, it leaves individuals hyponasal.

## Chapter 3

### DETAILED DISCUSSION OF THE OBTURATOR APPLIANCE AND PROGRAM

An obturator is "an artificial disc, plate, or bulb used to partially or completely close an opening; used especially in cleft palate cases" (Travis, 1957, p. 16). This speech appliance can be divided in three sections: the anterior, velar, and pharyngeal. Each of the sections is distinguished by its function, construction, and location.

The anterior section covers and is supported by the hard palate and maxillary dentition. It provides retention by clasps or stainless steel bands (Fig. 2). These bands are cemented to the maxillary second primary molars or the first permanent molars. The anterior section's primary function is retention and anchorage, but

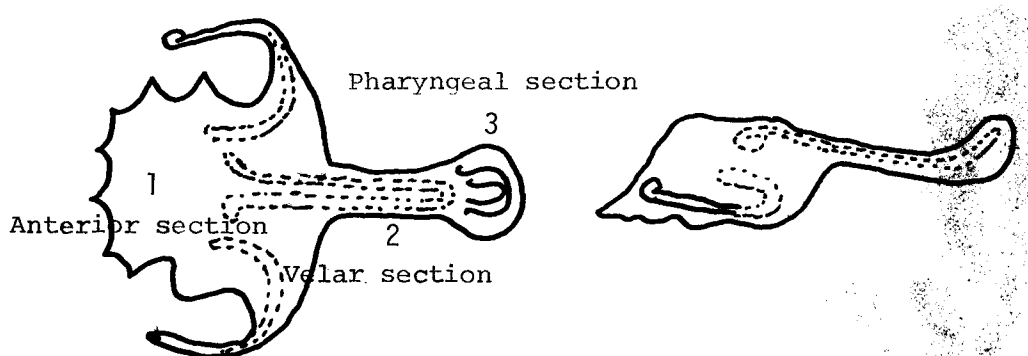


Figure 2. The Three Sections of The Speech Appliance



it may assist in mastication and closure of the palate in patients with an unrepaired cleft of the hard palate.

The velar or palatovelar portion crosses the soft palate and supports the pharyngeal bulb. It is primarily used as a connecting and stabilizing device. It may function as an obturator in cases of an unrepaired soft palate and, thus, contribute to oral-nasal separation.

The posterior pharyngeal bulb or speech bulb is located within the nasal pharynx. The bulb acts as an obturator. It provides palatopharyngeal approximation during speech yet permits nasal breathing and comfortable deglutition. There is individual variation in the size, shape, and position of the bulb. The placement should be far above the tongue following the contour of the soft palate, such that it is in the area of the closest approximation of the soft palate to the posterior pharyngeal wall. This placement allows the musculature of the soft palate and pharynx to contract around the obturator.

The construction of the final speech appliance is a gradual process. The initial prosthesis, constructed in one or two days, contains all but the pharyngeal bulb. There is only a bare wire in the pharyngeal segment. Gradual additions are made to the tail piece (or pharyngeal bulb) in subsequent visits. The additional material is a soft, acrylic resin which is molded by a child's palatopharyngeal musculature. The child's adjustment to the appliance usually takes two to three weeks. Additions to the posterior portion are done in two to four visits over a period of two to four weeks. A great majority of children, over 90 percent, readily adapt to their

obturator via this gradual building process (Blakeley, 1979).

In summary, the appliance is designed to facilitate oral function, ease of modification, and comfort. The appropriate size and shape for a given individual is critical to success. The Appendix contains 12 criteria proposed by Weiss (1974) for the fitting of a prosthesis.

From a speech and language pathologist's point of view the optimal placement time for a speech appliance is during the years of most rapid maturation of articulation (ages three to five). According to Blakeley (1979) early placement is designed to reduce the chance of learning faulty articulation which is common in children with congenital palatal insufficiency. At this age, generally three years, it can be determined that the pressure consonants have not been learned. The appliance allows for the distinctive features of plosives and fricatives to develop in a normal manner. It can help eliminate faulty speech habit (Blakeley, 1979; VanDemark, 1966; VanDemark and Morris, 1977).

An obturator reduction program is a possible addition to a standard speech appliance program. The reduction program attempts to stimulate muscular activity to eventually produce an acceptable speech pattern that can continue without the appliance. Another goal of muscle stimulation is to improve chances of acceptable speech patterns following secondary surgery. The combination of the two programs, speech therapy and obturator reduction, allows a greater decision making period for secondary surgery, permanent prosthesis, or elimination of the appliance altogether. The time of this decision

varies greatly with individual patients, but it generally occurs near puberty.

The initial objective of an obturator reduction program is for a client's speech to be mildly hyponasal after placement of the prosthesis. This is achieved by gradually adding acrylic resin to the tail piece until the hyponasal quality is achieved. The mildly hyponasal speech tends to interrupt a patient's previous nasal speech pattern. It forces the sounds and air out of the mouth and allows an oral rather than nasal habit to be established. The large obturator makes it difficult for the client to nasalize even when he/she relaxes the pharyngeal wall.

Once an oral pattern is established, reduction of the obturator can begin. The purpose of this is to attempt to provide a continuous challenge to the velopharyngeal muscles. This is achieved by the systematic removal of small segments of acrylic resin from the pharyngeal segment of the obturator. The removal is mainly from the lateral margins of the pharyngeal bulb. This encourages the muscles to move further toward the midline to achieve closure. The reductions are gradual and the clients are continually monitored. Clients are seen every three to five months.

An average of three reductions occur during the first year for a majority of clients, with five reductions the second year. This sequence of reductions may be delayed for a few clients for one or two years. The continual monitoring of a client is essential. Blakeley (1979) stated that

the pharyngeal development is progressive, so that frequent

observations of the pharyngeal section is necessary to prevent discomfort, stenosis, and irritation, and to keep the contact in a functional relationship (personal conversation).

If adequate reductions of the obturator do not occur, there is the possibility of developing undesirable movements or increased dependence on the appliance.

One method of determining the timing of reductions is based on observations of speech production. The nasal flutter test and nasal listening tube are two procedures used in the Oregon program for judging nasality. The nasal flutter test alternately pinches and releases the nasal airway when a client produces a prolonged /i/ or /u/. Excessive nasality will become acoustically evident as a pulsating sound. This perceptible change in resonance when the nares are occluded is an indication of inadequate obturator fit.

The nasal listening tube allows detection of nasal snores and nasal emissions generally not evident in more natural listening situations. One nasal olive is placed in a client's nostril, a second is placed in a clinician's ear. The client reads a passage or repeats words that do not have nasal consonants. The listening tube tends to exaggerate nasal emissions which are not as obvious in normal speech. It can also be used to judge slight changes in resonance. Other procedures include the use of an oral manometer, X-rays, and a puffed cheek test.

A visual method used in the program was described by Weiss and Lewis (1972). Pressure indicator paste, placed on the pharyngeal bulb, is used to indicate the location and extent of soft tissue contact with the pharyngeal segment of the obturator. The paste is brushed

onto the pharyngeal segment. A client wears the obturator and speaks for a few minutes. The extent of contact is visually evident by patterns on the obturator. These patterns are described as pressure points (denuded areas), contact points, and areas of no contact with the palatopharyngeal tissue.

The pressure areas can be reduced until they are ones of mild contact. Slight nasality may be observed at this point. In theory, the slight nasality will disappear as compensation occurs. The pressure indicator paste also reveals areas of undue discomfort which may inhibit palatopharyngeal movement. The pressure indicator paste thus complements judgments of acoustically perceived hypernasality and nasal emission. It can increase accuracy in the reduction of the obturator.

The obturator program under study uses longitudinal data of a client's voice and articulation abilities, X-rays, and diagnostic articulation therapy. The decision for placement of the client in the obturator program is based on the findings of the prosthodontist and surgeon, as determined at a team meeting. Many of the clients in the program were followed annually from one year of age by the different disciplines. Team decision was used to indicate secondary management.

Patients generally continue in the obturator reduction program until no further reductions can be made on the obturator or until they do not need the obturator. When the speech/language pathologist and dentist judge that no further reductions can be made, or the possibility of elimination of the obturator is unlikely, a team meeting is held to discuss possible alternatives. These include secondary surgery, permanent prosthesis, or continued use of the speech appliance.

Numerous team decisions may have to be made in situations where the family and/or patient may be unhappy with the appliance, physical growth occurs such that a new appliance must be built, physical growth has affected the patient such that he now needs the appliance (i.e., it was reduced out at an earlier age), or when the patient is 21 years and cannot continue to be served by the center.

Weiss and Wong (1972) indicated that age was a critical factor for the success of the obturator reduction program. A younger patient was noted to have a greater potential for adaptation and length of time in the program was of little significance. Other factors which influenced the success of the program were family support and cooperation, understanding, and acceptance, regular use and proper maintenance of the appliance, and a need for continual check-ups and observation.

## Chapter 4

### RESULTS AND DISCUSSION

Fifty-four clients with a variety of etiologies participated in an obturator reduction program at the University of Oregon Medical School. The clients were grouped by etiology from the most severe contributing factor causing velopharyngeal insufficiency to the least. Nine groups are compared in Table 1 in relation to their final status in the program. Patients were also grouped by this final status and analyzed in terms of voice and articulation although they were not consistently evaluated. Three other studies that analyzed final voice and articulation from obturator programs are reviewed.

Contributing factors for velopharyngeal insufficiency, noted in Table 1, demonstrate the number and percentage in the nine groups. Patients with cleft palates were differentiated into traditional categories of unilateral cleft lip and palate, bilateral cleft lip and palate, cleft of the hard palate, and cleft of the soft palate. The six patients with a congenital short palate had a history of nasal regurgitation since birth and speech was characterized by nasality. One patient's speech was nasal following a tonsillectomy and adenoidectomy. Evaluation indicated palatal asymmetry. Two patients were categorized as dysarthric and apraxic because their speech disorder was the major contributing factor to hypernasality.

The final status for these patients was determined from a

Table 1  
Final Status and Cause of Palatal Insufficiency

Final status	Group*									Total	Percentage
	1	2	3	4	5	6	7	8	9		
Palatoplasty†	8	4	5	2	1	0	2	0	0	23	42.64
Reduced out	4	3	2	1	5	1	0	1	1	18	33.34
Permanent prosthesis‡	4	1	0	1	0	0	0	0	0	6	10.50
Moved before program completed	3	1	0	1	0	0	1	0	0	6	10.50
Patient chose to terminate	<u>0</u>	<u>1</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>1</u>	1.90
TOTALS	19	10	7	5	6	1	3	1	1	54	

\*Group 1 = unilateral cleft lip and palate.  
 2 = bilateral cleft lip and palate.  
 3 = cleft hard palate.  
 4 = cleft soft palate.  
 5 = congenital short palate.  
 6 = palatal assymetry.  
 7 = submucous cleft palate.  
 8 = dysarthric.  
 9 = apraxic.

†One patient had a teflon injection approximately three years after completion of the reduction program.

‡Two patients had permanent bifed obturators following several pharyngeal flap operations.



final speech and language report in their charts. Three major categories were used: (1) the appliance was reduced and finally removed, (2) palatoplasty or secondary surgery was performed, or (3) permanent prosthesis was recommended. These categories are used to describe the data.

A few patients did not conform to the above categories. Six of the patients moved before completion of the program and one patient chose to have the obturator removed before the staff felt the program was complete. One patient had the obturator reduced out at an early age; this resulted in later secondary surgery (an implant operation). Another patient who had had two unsuccessful attempts at secondary surgery was fitted with a bifid obturator; a third surgical procedure was being considered at the time of this study.

The ages of the subjects fitted with speech prostheses varied between two years, nine months and nineteen years, seven months. The average age was eight years, four months. The final status of the patients is used to describe the data concerning the length of time the groups of patients wore their appliances.

Eighteen obturators were reduced and totally eliminated. Clients wore the obturators for an average of four years, three months; the range varied from nine months to nine years, six months. The average age at the time of appliance removal was thirteen years, one month; the range varied from five years, eight months to nineteen years, two months. At the time of this study the patients who continued to wear speech appliances had worn them an average of seven years; the range varied from one to eleven years. These patients were last seen when each was eighteen years old.

Twenty-two patients received palatoplasties. They wore their appliances for an average of seven years, one month; the range varied from two years, two months to sixteen years, one month. Age at the time of surgery ranged from seven years, two months to twenty years, one month; the average age was fourteen years, six months.

The average size of the obturators was 29.02 mm laterally and 12.12 mm in the anterior-posterior (AP) dimension. They were, on the average, reduced by a total of 18.70 mm laterally and 5.40 mm AP. This figure for the total reduction includes patients whose obturators were reduced out. The amount of reductions for patients with a permanent prosthesis was 9.38 mm laterally and .28 mm AP. The average number of reductions was 4.35 mm with a range of 0-12.00 mm laterally and 2.10 mm AP with a range of 0.00-7.00 mm.

Many of the reductions, especially AP reductions, were not measurable. They were described as planed or shaved. The amount of reductions for each session ranged from .70-13.20 mm laterally with an average of 4.60 mm. The average AP reduction was 2.06 mm with a range of 0.00-9.50 mm. There were more frequent reductions and a larger amount of material taken from the lateral dimension. This is due to the minimal amount of compensation that occurred in the anterior-posterior dimension.

In some cases obturators had to be increased in size. These enlargements were generally based upon nasal speech, inconsistent use of a speech appliance, growth, or no change in vocal quality or muscle compensation. These enlargements were influenced by a patient's length of time in the program. Physical growth during puberty increased the dimensions of the pharyngeal area and many clients were unable to

compensate. Inconsistent use of an appliance also affected a client's ability to compensate and the client was unable to adjust to the reductions. The average number of increases was .48 mm with a range of 0-5 mm per client (Table 2).

A total of 26 new appliances were built for the clients. Eleven were built because of growth. Others were built for changes

Table 2  
Causes for Obturator Enlargement

Cause	Number
Voice	13
Inconsistent use	3
Pubescent growth	5
No change	<u>5</u>
TOTAL	26

in appliance type, loss of an appliance, or changes in physical structures, e.g., surgery (Table 3).

Clients in this program were seen on an average of every six months with a range of 2.4-13.4 months between visits. For the total program, including rechecks following palatoplasties or following obturator removal, clients were seen for an average of 16.2 sessions with a range of 6-33 sessions. For the obturator reduction program only they were seen for a total of 12.37 sessions with a range of

Table 3  
Placement of Additional Appliances

Cause	Number
Lost	2
Extra	1
Hayrake addition	2
Not worn and growth	11
Surgically affected	2
Permanent bifed obturator	1
Permanent obturator	5
Lift appliance	1
Bifed obturator (temporary)	<u>1</u>
TOTAL	26

of 5-27 sessions. Most clients were initially seen every 3-5 months in the beginning two years and then less frequently. Contributing factors to a client's length of time in the program were maturation (growth), surgery, and length of the decision making period.

Growth of the laryngeal area had a positive effect on vocal quality for some patients who had a palatoplasty during puberty. Many of these patients had a wide based pharyngeal flap. Growth in this area decreased hyponasal quality to a more normal vocal quality.

For a few patients wearing obturators, or for those who had their obturators reduced out, there was a negative effect caused by

growth. These patients were unable to continue to compensate during the growth period.

Surgery performed on some individuals in the program affected the length of time that they spent in the program. A few of the surgeons were less successful in providing specific procedures than others. In these cases it was sometimes advised that the decision for surgery be postponed. Some of these patients went on to a permanent prosthesis while others had surgery at a later date when a new surgeon was assigned.

The current or final voice and articulation abilities of the clients were analyzed. In general, vocal quality was described in the final speech reports; however, when articulation was normal, past reports were utilized. No systematic evaluation procedure was used by clinicians in the program to describe vocal quality or articulation. Three categories for articulation skill were provided: within normal limits, mild, and moderate-severe.

Four categories were used to describe vocal quality: hypernasal, hyponasal, normal, and within normal limits. The distinction between normal and within normal limits was based on subclinical tests (i.e., a nasal olive noted nasal emission or nasal quality during speech that was undetected in a normal conversation).

The severity of a patient's vocal quality as hypernasal or hyponasal was not analyzed; their quality was generally described as mild or moderate. Table 4 contains the number of patients assigned to each of the categories for articulation and voice. The majority of patients, 74 percent, had normal or within normal vocal quality.

Table 4

## Final Status of Patients' Articulation and Voice

Final status	Articulation			Voice			
	Within normal limits	Mild	Moderate- severe	Hyper- nasal	Hypo- nasal	Normal	Within normal limits
Reduced out	12	2	3	4	0	9	4
Out; patient's choice	0	2	0	0	0	0	2
Permanent prosthesis	4	0	2	0	0	3	2
Wearing obturator	0	0	1	1	0	0	0
Bifed obturator	0	0	1	1	0	0	0
Implant	0	1	0	1	0	0	0
Palatoplasty	16	3	2	1	6	11	3
Moved	<u>3</u>	<u>1</u>	<u>1</u>	<u>0</u>	<u>0</u>	<u>4</u>	<u>0</u>
TOTALS	35	9	10	8	6	27	11

Sixty-eight percent of the patients who had their obturators reduced out had normal vocal quality. Sixty-six percent of the patients who had palatoplasties had normal vocal quality and 70 percent of the patients who continued to wear their obturators had normal vocal quality.

The patients in this study were not, unfortunately, systematically evaluated in terms of changes in vocal quality and articulation made throughout the program. A small number of patients had tape recordings to document speech changes; for the other patients only brief written reports were used. The use of a more systematic detailed account of the changes that occurred in speech abilities would help to support the effectiveness of an obturator program. It would also help to substantiate the timing at which the obturator program is most effective.

A majority of the patients received speech therapy. The timing and quality of therapy were uncontrolled although the majority were serviced by public schools. Recent research by a number of authors offered some general conclusions of the effect of obturators on voice and articulation.

Nasal quality was studied by Fletcher et al. (1974) by use of an instrument, the Tonar II. Nasal quality or nasalance was defined as a "descriptive term for acoustical comparison of nasal vs oral resonance, specifically derived from instrumental procedure excluding human perception" (p. 737). The treatment was by sequential measurement of nasalance. It helped define modifications of the prosthesis and compared patients with and without prostheses. The results

indicated that some patients improved. The goal of normal speech was obtained as follows:

1. 1 of 4 with palatopharyngeal hypoplasia.
2. 1 of 3 unrepaired cleft of palate.
3. 7 of 13 surgical repaired palatal clefts.
4. 6 of 12 surgical incision of maxillary neoplastic.

The discrepancy was again dependent on age and articulation skills of the clients.

Shelton, et al. (1964) found no significant difference in speech due to surgery of prosthetic restoration. They postulated that closure is more critical for articulation acquisition than for maintenance of articulatory pattern, and that conservative reductions are necessary to prevent impairment of articulation development. A later report by Shelton et al. (1968) reported the significance of velopharyngeal closure patterns, extent of palatopharyngeal gap, and articulation. Clients with better articulatory skills profited more from the gradual effectiveness of the reduction program. In the study by Weiss and Wong (1972), young clients had a greater potential for adaptation.

A study by Subtelny et al. (1966) of obturation use indicated that intelligibility improved, but that normal intelligibility was not achieved for all subjects. They explained the variability in their results by the acoustic features of nasal consonants and plosives and the characteristics of the subjects. The successful speakers had superior articulation skills and more adequate obturation. Some of the subjects were unable to obtain adequate nasopharyngeal obturation. Physical structures were thought to affect the attainment of obturation



(i.e., those with a short soft palate were more successful). Others found that defective articulation behaviors persisted (Subtelny et al., 1966).

### Summary

When subjects entered the obturator reduction program, there were none who had soft palate contact with the posterior pharyngeal wall. All subjects were unable to eliminate hypernasality. All produced plosives in a clinical test setting. Because the program provides services for individuals up to the age of 21 years, a majority of cases were discontinued at the time of this study. Of the 54 patients reviewed in this study, six moved before completing the program (all were wearing an appliance), and one had died. Eighteen obturators were reduced and totally eliminated in 13-116 months; 22 obturators were significantly reduced in size, then substituted for pharyngeal flaps after 26-248 months when speech was normal and further pharyngeal and/or palatal compensations were considered by team members to be unlikely.

On the average, obturators were reduced 18.7 mm laterally and 5.4 mm in the anterior-posterior dimension. The clients were seen an average of sixteen sessions at average intervals of six months. Auditory and visual clinical tests were utilized to judge the amount and extent of the reductions and their communication effectiveness.

One of the major concerns with the obturator reduction program is its usefulness in comparison to secondary surgery. One consideration is that, at the present time, there are no specific guidelines to

differentiate which client would benefit from surgery versus an obturator program. This review of the obturator reduction program was unable to answer three questions.

1. When should an alternative treatment program be utilized?
2. How do changes in voice and articulation that occurred during the program compare to the results following surgery?
3. How does a documentation of muscle changes that occurred by the reductions compare to those changes that may occur following surgery or maturation?

This study did, however, suggest some interesting findings concerning time of treatment. The review noted that some patients continued in the program for as long as 132 months before surgery was performed. Many of these clients had few noticeable changes in the obturator or in their articulation and vocal quality throughout the duration of treatment.

It was noted in the files that, in relation to time, the reduction process took as long as nine years, six months before completion. These examples seem to indicate that client problems may have been alleviated at an earlier date or that changes may have occurred more rapidly following a different intervention schedule. For some patients it appears that alternative treatments were possibly not utilized quickly and efficiently, therefore this program may be more costly and time consuming than is necessary. On the other hand, the obturator program was found to be the most efficient for some clients. It is hoped that future research will allow more precise prediction of the most appropriate treatment program for each client.

The obturator reduction program is unique at the University of Oregon Medical School. It includes the combined skill and cooperation of a dentist, surgeon, and speech pathologist. Specific training for the speech pathologist and dentist is required in order to implement this model program.

The results of this study and observation of the program in January and June 1979 found it to be a favorable approach for the development of normal articulation and vocal quality for some patients with velopharyngeal insufficiency. The patients and their families were generally satisfied with the results and implementation. There are few risks involved in the utilization of this program compared to those that may occur during surgery. It was thought to have influenced the success of later pharyngeal flap operations by improving speech, establishing a normal monitoring system, and increasing muscle compensation. The obturator reduction program improved the voice and articulation ability of a majority of its clients and successfully eliminated the need of the obturator in over 30 percent of its clients.

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A P P E N D I X

## TWELVE CRITERIA FOR THE FITTING OF A PROSTHESIS<sup>1</sup>

1. Acceptance and understanding of wear and care for the obturator by the patient and his parents.
2. Adequate space between the pharyngeal segment and the pharynx at rest, permitting freedom of head movement, absence of irritation, and postnasal drainage.
3. Secure but not unusually tight fit of the palatal segment including the wire retention bands.
4. Thin palatal segment that does not interfere with lingual function for speech and vegetative purpose.
5. Palatal segment that preserves the alveolar rugae for tactile feedback and for more tongue-tip space.
6. Velar segment that impinges on and slightly elevates the velum at rest.
7. Velar segment that bypasses the uvula when it is anatomically normal.
8. Pharyngeal segment that is placed at the level of maximum velopharyngeal construction, as determined by X-rays and dental impressions.
9. Pharyngeal segment that permits normal production and resonance of nasal as well as nonnasal sounds, except when the patient has moderately impaired articulation and resonance; then the pharyngeal segment is overenlarged to help break down rapidly the detrimental nasal habit.
10. Pharyngeal segment of appropriate size to challenge greater pharyngeal muscle movement.
11. Absence of any pressure points determined by and resulting in craters of displaced pressure indicator paste on the pharyngeal segment.

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<sup>1</sup>C. E. Weiss, 1974, "The Speech Pathologist's Role in Dealing with Obturator Wearing School Children," *Journal of Speech Hearing Disorder*, 3:162.



12. Relatively short wire clasps on the palatal segment so they do not project too far forward and become cosmetically detracting.