Speech obturators: A viable approach to the treatment of velopharyngeal insufficiency

Karen Hart

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SPEECH OBTURATORS: A VIABLE APPROACH TO THE TREATMENT OF
VELOPHARYNGEAL INSUFFICIENCY

By
Karen Hart
B.S., University of Wyoming, 1976

Presented in partial fulfillment of the requirements for the degree of
Master of Arts
UNIVERSITY OF MONTANA
1984

Approved by:

[Signatures]
Chairman, Board of Examiners
Dean, Graduate School

Date 3/20/84
ACKNOWLEDGMENTS

For unselfishly giving of their time and knowledge, sincere thanks are given to the OHSU, CCD Staff. In particular, a special note of gratitude goes to Dr. Robert W. Blakeley and Dr. C. Donald Nelson for freely giving of their guidance and support. And finally, this paper is respectfully dedicated to the memory of Dr. Carol Shigetomi for giving, most importantly, of herself. Her quiet, gentle ways, warm smile, ready laughter, and professional dedication are gone, but not forgotten.
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Chapter</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ACKNOWLEDGMENTS</strong></td>
<td>ii</td>
</tr>
<tr>
<td><strong>LIST OF TABLES</strong></td>
<td>iv</td>
</tr>
<tr>
<td><strong>Chapter</strong></td>
<td></td>
</tr>
<tr>
<td>1. <strong>INTRODUCTION</strong></td>
<td>1</td>
</tr>
<tr>
<td>2. <strong>CLEFT PALATE AND SPEECH HABILITATION</strong></td>
<td>3</td>
</tr>
<tr>
<td>Types and Styles of Speech Prostheses</td>
<td>4</td>
</tr>
<tr>
<td>OHSU Obturator Construction and Reduction Program</td>
<td>6</td>
</tr>
<tr>
<td>The Role of Velopharyngeal Functioning in the Production of Speech</td>
<td>9</td>
</tr>
<tr>
<td>Common Speech Characteristics Associated With VPI</td>
<td>11</td>
</tr>
<tr>
<td>Suggested Guidelines For Utilization of Obturators In Cases of VPI</td>
<td>15</td>
</tr>
<tr>
<td>3. <strong>METHODS</strong></td>
<td>19</td>
</tr>
<tr>
<td>Subjects</td>
<td>19</td>
</tr>
<tr>
<td>Procedure</td>
<td>20</td>
</tr>
<tr>
<td>4. <strong>RESULTS</strong></td>
<td>21</td>
</tr>
<tr>
<td>5. <strong>DISCUSSION AND CONCLUSION</strong></td>
<td>24</td>
</tr>
<tr>
<td><strong>BIBLIOGRAPHY</strong></td>
<td>30</td>
</tr>
</tbody>
</table>
# LIST OF TABLES

<table>
<thead>
<tr>
<th>Table Number</th>
<th>Table Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Distribution of Cases &amp; Status in Obturator Reduction Program</td>
<td>21</td>
</tr>
<tr>
<td>2</td>
<td>Range &amp; Mean Regarding Age, Lateral &amp; Anterior-Posterior Obturator Reductions, and Amount of Time Obturator Worn in 25 Patients</td>
<td>22</td>
</tr>
<tr>
<td>3</td>
<td>Voice Quality of 25 Obturator Patients</td>
<td>23</td>
</tr>
</tbody>
</table>
Chapter 1

INTRODUCTION

The use of palatal prosthetic devices as a means of creating sufficient velopharyngeal closure for speech dates back over 400 years. Amatus Lusitanus was the first to construct a speech appliance in 1511 and place it in the mouth of one of his cleft palate patients in an attempt to improve speech (Weinberger, 1948). Prior to 1820 however, these devices were mainly used to obturate acquired clefts of the hard palate, and little attention was given to their use in the rehabilitation of velopharyngeal insufficiency (VPI). Shortly thereafter, men such as Delabarre and Snell in 1820, McGrath in 1860, Kingsley in 1880, and Case in 1921 began to experiment with the design and function of palatal prostheses (also referred to as "obturators") and promoted their use in patients with VPI.

With a history of some 400 years behind it, it would seem safe to assume that the employment of obturators in patients with cleft palates and VPI is a commonly accepted, conservative and efficient form of treatment, but such is not the case. In a recent survey conducted by Schneider and Shprintzen (1980) 1,000 speech pathologists were asked to complete questionnaires regarding preferred management techniques of cleft palate patients who displayed VPI. Of the 592 who responded, the majority (80%) advocated the use of speech therapy (e.g. articulation techniques, palatal exercises and stimulation) as primary means of treatment, even though little evidence exists to support the success of this type of approach in correcting VPI (Shelton, Morris, & McWilliams, 1973; Spriestersbach,
Dickson, Fraser, Horowitz, McWilliams, Paradise, & Randall, 1973). The use of obturators was favored by 10% of those surveyed. Blakeley (1983) also notes that the recommendation for employment of speech prostheses is often a low priority option with surgeons who also manage the cleft palate population. When use of an obturator is recommended, that decision is generally made either because the surgeon has had to postpone operating due to the patient's poor health, or the result of the secondary surgery* has failed to eliminate the VPI.

The reverse of this philosophy to use speech prostheses only as a last resort in treatment of VPI, exists at The Oregon Health Sciences University (OHSU), Craniofacial Disorders Clinic at the Crippled Children's Division (CCD). Since 1960, as part of the Craniofacial Disorders Clinic, many patients with VPI have been successfully managed via an Obturator Reduction Program. The purpose of this paper is to review the current status of this program based on a chart review of 25 patients with diagnosed VPI. The nature of the VPI of these patients is due to various structural anomalies including congenitally short palates, submucous clefts, and clefting of the hard and soft palates. Areas which will be surveyed include:

I. Obturator Status
   A. % removed
   B. % replaced by pharyngoplasty
   C. % in use by these patients at the close of the study

II. Average Reduction Of Obturators In Millimeters Based On Measurements Of
   A. lateral aspects
   B. anterior-posterior aspects

III. Average Age and Length Of Time Patients Are In The Program
* secondary surgery, as referred to in this paper, includes surgery performed subsequent to initial repair of the palate.
Chapter 2

CLEFT PALATE AND SPEECH HABILITATION

Initial repair of cleft lip is currently being conducted on infants when they reach three to four months of age. Primary repair of the palate, both hard palate and soft palate, typically follows at 16 to 18 months of age (Trier, 1982). This surgical time-table does vary with reported cases of cleft lip repair being carried out on infants as early as 48 hours after birth followed by cleft palate repair at 16 weeks of age (Desai, 1983). However, in the Portland area, most primary palatal repair is initiated between the ages of 16 to 24 months (Blakeley, 1984). The results of this primary surgery are influenced by a number of factors. Expertise of the surgeon, procedure employed, amount of tissue available for reconstruction, age at which surgery is performed, and even the criterion by which "success" of the operation is defined are all important variables which can make the difference in the outcome of surgery (Graham, 1979; Ross & Johnston, 1972).

What is perhaps the biggest physiological hurdle following primary surgery is that of adequate velopharyngeal functioning for speech. Satisfactory movement of the velopharyngeal valve for speech purposes following primary surgery is reported to range from 60 to 94 percent (Bradley, 1979; Riski & Millard, 1979; Yules & Chase, 1971). When secondary surgical intervention such as posterior pharyngeal flaps or push-backs are used in an attempt to correct VPI, the outcome again varies from a 60 to 95 percent success rate (Hogan, 1973). Often, as mentioned earlier, it is usually not until failure of secondary surgery to establish velopharyngeal
competency has occurred that the use of an obturator is considered as a viable option for improving speech. And, prior to 1960 few attempts were recorded in the literature to modify an obturator's size or shape following its initial construction. Thus, an obturator was generally regarded as a permanent, as opposed to a temporary, appliance (Blakeley, 1964).

**TYPES AND STYLES OF SPEECH PROSTHESSES**

Three general designs of speech prostheses have evolved out of the past 400 years of research. One style known as the "hinged or movable" prosthesis, was popular during the nineteenth century. The construction of this model was based on an attempt to simulate the natural physiological movements of the normal functioning soft palate, but as is so often the case when man attempts to recreate the work of mother nature, the ensuing results ended up to be little more than poor quality imitations. Durability of the hinged section was found to be poor, construction and repair was awkward, and keeping the prosthesis clean was difficult (Adisman, 1971).

A second type of obturator, the "meatus", was constructed for use primarily in situations involving surgically unrepaired cleft palates in adults. This device extended into and occluded the nasal cavity, but did not provide velopharyngeal obturation. Its main function was to provide simple access and obturation of the nasal cavity.

The third general type of prosthesis is the "fixed or immobile" design which is most commonly produced today. This prosthesis is composed of three main sections including: (1) the palatomaxillary section which covers the hard palate and allows for retention and stability of the obturator by attachment to the patient's second primary or first perma-
dent molars. This section can also be constructed to include artificial teeth for improvement of dental appearance and occlusion; (2) the palato-velar extension section which extends posteriorly along the length and contour of the soft palate and may curve slightly upward into the nasopharynx. This tail piece section is usually constructed out of acrylic resin and reinforced with a metal wire insert which is shaped into a hook at the posterior border allowing for retention of the third section; (3) the nasopharyngeal "bulb" section which serves to establish velopharyngeal competency. The construction and subsequent reduction of the speech bulb is a complex procedure demanding an experienced team effort to achieve the best results. The procedure utilized by OHSU Obturator Reduction Program will be discussed in the following section. However, before leaving this discussion, one further point needs to be clarified.

As once noted by Harkins and Koepp-Baker (1948) "... a speech aid is not so much an instrument to restore lost parts as it is to create a condition whereby the residual tissue may perform functions by compensation, or by the approximation of normal movements of speech production" (p. 27). As an extension of this philosophy, the utilization of obturators at OHSU is considered to be a temporary step in the habilitation/rehabilitation of VPI. Once a patient is fitted with an obturator he/she is subsequently followed and placed on an Obturator Reduction Program, the goals of which as explained by Blakeley (1984) include: (1) elimination of nasal emission and hypernasal voice quality; (2) enhancement of articulation development (i.e. the 16 air pressure consonants); (3) conditioning of the velopharyngeal musculature to work at its particular peak efficiency during speaking; and (4) provoking contraction of the muscles of the pharynx (and possibly the velum) to stimulate maximum velopharyngeal
functioning beyond expected limits leading to total removal of the obturator from the mouth or enhancement of future secondary surgery for speech purposes.

OHSU OBTURATOR CONSTRUCTION AND REDUCTION PROGRAM

As has been repeatedly advocated in the literature (Bzoch & Williams, 1979; Harding, 1979; Holve, 1982) care and management of the patient with cleft lip and palate requires a cooperative interdisciplinary approach. The Obturator Reduction Program at OHSU continues to function under this supposition with a high degree of communication flowing between those professionals who are directly involved in assisting the cleft palate patient obtain normal speech. This includes specialists in the fields of plastic surgery, prosthodontics, speech pathology, audiology, the patient, and the patient's family.

In constructing an obturator, a dentist and speech pathologist work closely together. Each obturator is custom-made to ensure the best possible fit, function, and comfort for each individual. Following construction of the first two sections of the obturator, a process which is usually done in one to four visits (average time per visit is one hour), an adjustment period of two to four weeks is allowed for the patient to adapt to wearing the device. The speech bulb section is then gradually added to the tail piece and generally requires another four visits for completion. Material chosen for construction of the bulb is that of a soft acrylic resin which can initially be easily molded by the patient's velopharyngeal musculature. At the outset of the program, the size of the bulb must sometimes be made larger than the actual velopharyngeal gap resulting in the patient sounding slightly hyponasal. The rationale behind this step as explained by Blakeley (1969) is
to reduce the tendency to relax the pharynx and thus maintain the "status quo" of hypernasal speech. Subsequently, as a child shifts his "habit" to that of oral rather than nasal speech, his obturator may by reduced considerably in size before this "new status quo" is challenged (p. 135).

Caution is exercised during this step to ensure that while the desired effect is achieved for speech, the bulb does not interfere with other functions such as breathing, deglutition, or drainage of mucous from the nasal area.

Following completion of all three sections of the prosthesis, the patient is then sent home to wear the appliance daily with removal only for cleaning after meals and at bedtime. Once voice and articulation are judged to be developing more normally, as assessed by the speech pathologist during the patient's follow-up visit, gradual reduction of the obturator is initiated every three to four months. Again the dentist and speech pathologist work side by side making lateral and/or anterior-posterior reductions of the bulb just enough to challenge velopharyngeal muscles to work to maintain the newly created atmosphere of orality of speech, while being careful not to push the capability of the muscles too far so that they give up and hypernasality returns in full force.

As a means of judging and achieving appropriate resonance balance, two quick assessment techniques are employed by the speech pathologist. One method for testing for the presence of nasality and nasal emission of air utilizes a device known as a "Nasal Listening Tube" (Blakeley, 1972). Far from being an elaborate, expensive piece of equipment, this device is composed of a 3/8" piece of rubber tubing, approximately 26-30 inches long, with two nasal olives inserted at either end. After ascertaining
that the patient's nasal airway is not blocked, one nasal olive is inserted into the patient's nostril with the other end extending into the ear of the speech pathologist. The patient is then asked to repeat words and phrases which contain various pressure consonants, but no nasal consonants, such as: "Go get a bigger egg; I have fifty-five fish; Peter has a paper puppy." During the patient's production, the presence of any nasal emission of air can then be detected auditorally as a "snoring" like sound or tactically felt inside the ear canal if the emission is of sufficient magnitude.

Another technique used is referred to as the "Nasal Flutter Test" (Blakeley, 1972). In this procedure the patient is instructed to produce and maintain a steady production of the vowels /i/ or /u/ while the speech pathologist rapidly and repeatedly pinches the nose. If too much sound is escaping through the nose it will be detected auditorally as a pulsing sound which is outside the accepted range of normal nasal resonance. In order to eliminate any possible occurrence of an artifact of nasality, the patient may also be instructed to produce /h/ prior to the vowel sounds as in /hi/ or /hu/.

Ultimately, as the individual's speech improves, the obturator bulb is gradually reduced in size until slight nasal resonance or nasal emission is perceived subclinically through the use of the listening tube during production of the pressure consonants. Monitoring of progress occurs approximately every three to six months until the obturator can be removed entirely from the mouth without producing any detrimental effect in the patient's speech, or until it is maximally reduced to the point where the individual does not demonstrate any further change in velopharyngeal ability to compensate. At this point two basic options
remain, the patient may elect to replace the obturator via secondary surgery, or postpone the decision regarding surgery and continue to wear the obturator on a maintenance basis.

When use of an obturator is followed up by surgical intervention, it is believed by some that a more successful outcome of the operation may result than if the secondary surgery was performed alone. As Mazaheri (1979) points out, "a pharyngeal flap works best if it is surrounded by dynamic musculature" (p. 297), and use of an obturator is felt by many to provoke an increase in velopharyngeal muscular activity (Blakeley, 1964; Blakeley & Porter, 1971; Cole, 1971; Lindgren, Adams, & Blakeley, 1964; Mazaheri, 1979; Millard, 1979). As advocated by Riski and Millard (1979), "it (the wearing of a speech prosthesis) may also increase muscle activity in such a way that the plastic surgeon's pharyngeal flap operation will be more successful" (p. 477).

THE ROLE OF VELOPHARYNGEAL FUNCTIONING IN THE PRODUCTION OF SPEECH

The relationship between velopharyngeal competency and speech production is closely interwoven. Ross and Johnston (1972) report, "incompetency of the velopharyngeal closure has greater effect on speech production and intelligibility than any other single factor associated with cleft palate" (p. 211). Subtelny, Sakuda, & Subtelny (1966) note, "compositely, increased nasal air flow, nasal resonance, and decreased oral pressure are physical modifications resulting from palatopharyngeal deficiency..." (p. 152). And, Bzoch & Williams (1979) warn that:

The failure of a speech pathologist to identify a basic problem of velopharyngeal insufficiency may result in compensatory speech habits that will require many months or years of intensive speech therapy (p. 7).

Therefore, the role and assessment of velopharyngeal functioning in the
development of adequate speech would thus appear to be of major importance.

Anatomically, the velopharyngeal valve is located at the juncture between the nasopharynx superiorly and the oropharynx inferiorly. Closure of the valve involves a sphincter-like action of the velum, posterior, and lateral walls of the pharynx (Zemlin, 1968). In regard to speech production, the primary function of this valve is to regulate the flow of air through the nasal and oral cavities and create the necessary oral air pressure and air flow for the production of plosives, fricatives, and affricatives. It also allows for the production of vocal quality without unnecessary nasality (Ruscello, 1982). However, as noted earlier, surgical intervention in patients with cleft palate cannot always restore normal functioning of this valve. Resulting VPI may be attributed to inadequate length or functioning of the repaired structures, scar tissue which restricts the mobility of the soft palate and prevents it from making the numerous, rapid adjustments needed in ongoing speech, or the occurrence of a growth spurt, such as during adolescence, in which the lower third of the face grows down and away from the base of the skull creating a reoccurrence of VPI (Ross & Johnston, 1972).

However, not all cases of hypernasality and nasal emission are due directly to VPI. As noted by Mason & Helmick (1979):

In contrast to the structural limitations...some children possess adequate anatomical structures for speech purposes following palatal surgery but have no experience in utilizing the velopharyngeal valve in speech (p. 432).

The strong influence of inappropriate habit patterns is further elaborated upon by Blakeley (1972):

Some children with severe cleft palate speech make their errors purely on the basis of habit. That is,
they are persisting with habits acquired at the time when they were first learning consonants and when their palates were either still un repaired or may not have been functioning satisfactorily. It seems incredible, but if no one shows these children how to change their speech, its defectiveness persists (p. 135).

Thus, not all patients with apparent VPI would necessarily benefit from intervention with a speech prosthesis. Prior to any treatment decision, careful and thorough evaluation of the individual's speech is essential.

COMMON SPEECH CHARACTERISTICS ASSOCIATED WITH VPI

The most common disturbance noted in the speech of a cleft palate speaker is that of hypernasality (Bzoch, 1971; Riski & Millard, 1979). Methods of detecting the presence of hypernasality (i.e. Nasal Listening Tube and Vowel Flutter Test) having previously been discussed, will not be repeated here.

Evaluation of articulation development is also of major importance, noting not only the number of errors made, but also the type of error. In a study by Bzoch (1956), a comparison between the production of speech sounds made by 120 preschool children without cleft palates and 60 preschool children with cleft palate was made. One conclusion drawn by the researcher was that production of the vowel and syllabic consonant sounds was not significantly distinguishable between the two groups. Therefore, these sounds were not regarded to be, "of sufficient importance to include in error pattern articulation testing" on the basis that they would not distinguish between articulation errors made by speakers with normal functioning oral structures and those without normal structure (Bzoch, 1979, p. 168). Morris (1979) also notes that the occurrence of distortions of /l/ and /r/ "made by speakers with cleft palate are essentially similar to those made by speakers with normal oral structures and are related to
inappropriate articulation movements which have been learned, probably movements of the tongue" (p. 197). Still others report that notable deviations of lingua-alveolar sounds (e.g. /l/) frequently do occur in cleft palate speakers due to overuse of the tongue blade instead of the tongue tip. It is suggested that this distortion stems from an early history of compensatory feeding behavior in which the blade and back of the tongue is used in a protective postural position to prevent the swallowing of too much milk at one time. As a result of this behavior, limited or inactive tongue tip movements may carry over into the production of lingua-alveolar sounds (Blakeley, 1972). This then leaves five remaining categories of speech sounds which are of major significance in the evaluation of cleft palate speakers including: plosives, fricatives, affricatives, aspirates, and nasals.

The type of plosive error commonly produced by a cleft palate speaker is that of either a nasal "snort" or a glottal stop (Blakeley, 1972; Bzoch, 1979). The production of fricatives and affricatives has been found to be even more sensitive to velopharyngeal closure than plosives since they require a greater sustainment of oral air pressure than do the plosives. While the production of plosives can occur with VPI of up to 5mm, fricatives and affricatives become distorted by gaps exceeding 2mm (Ross & Johnston, 1972). Attempts to produce fricative and affricative sounds may be accounted for by nasal fricatives in which the friction noise is created by air pressure being driven out the nose, or by pharyngeal fricatives in which the friction noise is created below the level of the oropharynx. In some cases, while visual appearance of the articulators may seem to be adequate, closer inspection of these structures typically reveal that the tongue is totally blocking the area of the oral cavity allowing all of the air to escape through the nose. A quick check of holding the nose closed for
a moment during production of the sound is useful. If production is totally interrupted in the process then it is evident that none of the sound is being made in the mouth. If production is suddenly strengthened upon occlusion, then it may be concluded that part, but not all of the sound is escaping out the nose. Some individuals may also demonstrate visible anterior "pinching" of the nares during production of these consonants in an attempt to prevent the escaping of the airflow through the nose. The occurrence of this behavior during the production of plosives and fricatives is a strong indicator of the presence of VPI (Blakeley, 1972).

Although it may not seem as likely that the production of nasal sounds could be greatly affected in cleft palate speakers, this is not always the case. It seems that once nasal resonance becomes the status quo, it may reduce the audible distinction needed to perceive the production of a nasal sound in contrast to the existing nasal resonance. "As perceptual distinctiveness of nasal consonants is reduced by the disturbance in resonance balance, auditory confusion between nasal and homophonous voiced plosive consonants may develop" (Subtelny et al., 1966, p. 153).

Along with noting the type of error being made, the examiner needs also listen for the occurrence of the correct production of any of these sounds regardless of where or when they may occur. If correct production is noted at some point during the evaluation, this is a positive indication that the individual does have the potential to produce the sound correctly, possibly without need of secondary surgery or prosthetic intervention. One may also attempt to check whether the errors which occur are functionally (i.e. habit) based by attempting to stimulate correct production of the sounds during the initial evaluation. One method utilized by Blakeley (1972) involves holding the individual's nose closed while briefly instructing
the patient on how to produce the desired sound. Assisting, by occluding the nose, allows for the use of 100% oral air pressure during production and provides the individual with the proper feel needed for correct production of the sound. If two or three correct productions are achieved, the next step is to release the nostril and see if correct production can be extended over at least one or two subsequent trials. If so, the individual can be considered to have good potential to achieve normal velopharyngeal closure.

In addition to assessing vocal quality and articulatory skills, one may also wish to perform an oral peripheral examination. Although adequate assessment of velopharyngeal functioning is not likely to be achieved based on visual inspection alone since the point of closure (or lack of closure) is usually hidden from view, useful information can be obtained regarding other oral structures such as the teeth, tongue, tonsils, and lips by doing an oral peripheral examination. Additional information which may be noted at this time include palatal thickness, rate and amplitude of palatal movement, presence or absence of lateral and posterior pharyngeal movement, degree of scarring, and presence or absence of palatal fistulas (Yules & Chase, 1971).

In general, it is not uncommon for cleft palate speakers to display speech characteristics associated with closure difficulties. Both articulation errors and a disturbance in vocal quality may or may not be associated with VPI. It is vital though that a thorough evaluation of both areas, including how the individual is currently functioning and their potential for improvement is assessed prior to any treatment recommendations.
SUGGESTED GUIDELINES FOR UTILIZATION OF OBTURATORS IN CASES OF VPI

Should the speech pathologist, having obtained all of the pertinent information discussed in the preceding section and subsequently establishing that VPI is present, always recommend to the team that the individual obtain an obturator? Of course, there is no treatment that is 100% effective with every individual. Fortunately, guidelines are available to help one judge whether a person with VPI is an appropriate candidate for an obturator and will likely profit from its use. Several of these guidelines will now be presented.

1. Age: The use of an obturator in the treatment of a young child, 2½-3 years of age, with VPI has been likened to 'putting a speech pathologist in the mouth of the child' (Blakeley, 1969). Obturation at an early age is felt to give the child an extra boost during this important time of rapid articulation development. By creating an environment of good oral air pressure, the obturator can help stimulate the normal development of plosives and fricatives, and interrupt the formation of any incorrect speech habits which may be taking hold. Young children have been found to tolerate and adapt to the wearing of obturators quite readily, especially when the parents approach it matter-of-factly (Blakeley, 1969; Shelton & Lloyd, 1963; Weiss, 1971). Older children, adolescents, and adults have also been successfully obturated. Thus the use of obturators covers a wide age range and few potential patients can be ruled out in their use simply because they are suspected of being too young. In fact, in many cases an obturator can be fitted at an earlier age than a pharyngeal flap (Blakeley, 1964).

2. A Cooperative Versus Coercive Environment: As with any type of
auxiliary device (e.g. glasses, hearing aid, corrective braces), an obturator is of little use if it is only used sporadically, creates a combat zone between the child and parent in its wearing, or does not receive proper care and maintenance. Thus if the parents are unreliable in keeping appointments, are unable to provide positive support and supervision in helping their child adjust to the wearing of an obturator, or if the child appears to be terrorized by the while process, little benefit will likely be gained by forcing a patient to obtain a speech prosthesis at that time. The use of a speech appliance requires on going care, maintenance, and active involvement by all concerned inorder to achieve the best results. Cooperation and dedication of the family is vital.

3. *Multiple Congenital Anomalies:* The incidence of cleft lip and/or palate may coincide with any number of other medical conditions which may be life threatening. After reviewing several studies dealing with the occurrence of coexisting congenital anomalies in cleft lip and palate cases, Ross and Johnston (1972) conclude that, "the incidence of associated malformations in CL(P) cases is approximately double that found in the general population" (p. 27). Thus recommendation of an obturator may be warranted as a more conservative option to alleviate the potential for further aggravation of the individual's coexisting medical problems.

4. *Type of Speech Error:* An obturator can help create oral air pressure needed in the production of plosives and fricatives, but it will not aid in the correction of articulation errors of a purely mat-
urational (e.g. f/θ, b/v) or functional nature. One cannot assume that all of a cleft palate child's articulation errors are directly due to
the cleft and will be subsequently corrected following obturation or secondary surgical intervention.

When using guidelines such as these, it is important to remember that in the correction of VPI, obturation and surgical intervention may both be compatible allies. Advantages offered by obturators are that their use does not interfere with potential growth and development of palatal and pharyngeal tissue, their size and shape can be modified any number of times to adjust to the child's changing needs brought on by growth, and they can offer the surgeon some guidelines in planning the shape, location, and placement of a pharyngeal flap if and when it is needed (Adisman, 1971; Blakeley, 1983). Disadvantages of obturators may include their need for daily insertion and removal requiring some degree of manual dexterity on the part of the wearer, their creation of an extra burden on maintaining adequate oral hygiene, and their capacity to break, become lost, or cause discomfort. Typically, as patients become older many opt for replacement of the obturator by surgical substitution in situations where the obturator cannot be totally reduced out of the mouth* (Blakeley, 1969). And, as previously noted, it is proposed by several investigators that the outcome of the ensuing surgery for speech purposes will more likely be successful for those patients who have utilized an obturator and had the opportunity to develop improved speech and maximum velopharyngeal functioning.

The recommendation of whether it is better to obturate or not to obturate will have to be made jointly by the team members. It is hoped though that this paper will resensitize the reader to the existence of

* the use of the term, "reduced out of the mouth" refers to the situation in which the obturator is taken completely out of the mouth.
a more conservative yet viable treatment option in VPI cases. Speech appliances should not be viewed as the last alternative to be pulled out of the hat when all else has failed, nor prescribed as being something which the patient will just have to put up with for the rest of his/her life.

As stated at the beginning of this paper, a descriptive review of some 25 patients from the OHSU Obturator Reduction Program will now be presented to allow the reader to judge the viability of this type of treatment approach with VPI.
Chapter 3

METHODS

Subjects

25 individuals from Dr. Robert Blakeley's 1981-1982 Obturator Patient Caseload* with VPI due to structural anomalies, and who had participated in the program for at least 12 months were randomly selected for inclusion in this study. Seven categories thus emerged as to the type of anomalies reviewed including those with (1) Congenitally Short Palates, (2) Velo-cardiofacial syndrome, (3) Submucous Cleft Palate, (4) Cleft of the Soft Palate only, (5) Bilateral Cleft of the Hard and Soft Palate, (6) Unilateral Cleft Lip and Palate, and (7) Bilateral Cleft Lip and Palate. No attempt was made to exclude any subject based on other factors such as age, sex, race, intelligence, socioeconomic status, or hearing status. Upon initial evaluation, no subject demonstrated adequate velopharyngeal competency for speech including the ability to produce plosives and fricatives correctly or prevent the occurrence of hypernasality. All but one subject had their obturator constructed and subsequently maintained by one of two local dentists who work closely with Dr. Blakeley. At the time of this study, some patients are being followed by Dr. Blakeley on a once a year monitoring basis having previously had their obturators reduced out, while others are still actively receiving modifications in the size and shape of their prostheses.

* 1981-1982 does not necessarily indicate patients' initial enrollment in the program
Procedure

The OHSU medical files of each of the 25 patients included in this study were carefully reviewed in order to obtain data in each of the following areas: (1) Type of Obturator Patient, (2) Age Initial Obturator Obtained, (3) Dates of Follow-Up Appointment, (4) Changes (i.e. reductions or enlargements) in Lateral Aspects of Obturator, (5) Changes (i.e. reductions or enlargements) in Anterior-Posterior Aspects of Obturator, (6) Judgement of Vocal Quality at Each Appointment, (7) Presence or Absence of Participation in Speech Therapy, and (8) Patient's Obturator and Voice Status at the end of this study.

Prior to beginning this review, this researcher spent two months observing Dr. Blakeley's Obturator Reduction Program and gained first hand experience in the protocol of how patients are managed. As previously described, all judgements of velopharyngeal competency following obturation, and subsequent reductions are based on subjective clinical perceptions of acoustic information obtained via the Nasal Flutter Test and utilization of the Nasal Listening Tube coupled with phrase and sentence imitation tasks. Additional information such as lateral still radiographs, cine-radiographics, or manometer readings was not collected in the Obturator Reduction Program at OHSU, CCD.
Chapter 4

RESULTS

A breakdown of the type, distribution, and obturator status of the 25 patients included in this review is presented in Table 1. At the time of this study, 5 of these patients had had their obturators reduced out of their mouths. As evidenced by this data, use of an obturator and its subsequent successful removal was not favored by any particular type of VPI patient. Another 7 cases subsequently underwent secondary pharyngeal flap surgery followed by removal of the obturator. This left approximately half of the 25 patients actively engaged in the Obturator Reduction Program at the end of this study.

Table 1
Distribution Of Cases & Status In Obturator Reduction Program

<table>
<thead>
<tr>
<th>Type Of Obturator Patient</th>
<th># Of Cases</th>
<th>Obturators Removed</th>
<th>Obturators Replaced By Pharyngeal Flap</th>
<th>Obturators Still In</th>
</tr>
</thead>
<tbody>
<tr>
<td>Congenitally Short Palate</td>
<td>5</td>
<td>2</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Velocardiofacial Syndrome</td>
<td>1</td>
<td></td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Submucous Cleft</td>
<td>4</td>
<td>1</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Cleft of the Soft Palate</td>
<td>1</td>
<td></td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Bilateral Cleft Palate</td>
<td>1</td>
<td></td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Unilateral Cleft Lip &amp; Palate</td>
<td>6</td>
<td>1</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Bilateral Cleft Lip &amp; Palate</td>
<td>7</td>
<td>1</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>Total</td>
<td>25</td>
<td>5</td>
<td>7</td>
<td>13</td>
</tr>
</tbody>
</table>
As shown in Table 2, the average age at which a patient initially received an obturator was 5 years, 7 months. Lateral reductions occurred more frequently and were of greater magnitude than anterior-posterior reductions for each subgroup. While enlargements and/or remakes of obturators were also periodically noted in the files, specific data regarding the amount of these changes were incomplete and thus not included in this report. It is also evident that the amount of time an obturator was worn and subsequently successfully removed was substantially less than when it was worn and later replaced by a pharyngeal flap.

Table 2

Range & Mean Regarding Age, Lateral & Anterior-Posterior Obturator Reductions, And Amount Of Time Obturator Worn In 25 Patients

<table>
<thead>
<tr>
<th>AGE OBTURATOR INITIALLY FITTED</th>
<th>N = 25</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.0 years-</td>
<td>Mean = 5 years, 7 months-14.4 years</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>OBTURATORS REMOVED</th>
<th>OBTURATORS REPLACED BY PHARYNGEAL FLAP</th>
<th>OBTURATORS STILL IN</th>
</tr>
</thead>
<tbody>
<tr>
<td>N = 5</td>
<td>N = 7</td>
<td>N = 13</td>
</tr>
<tr>
<td>Years Obturator Worn</td>
<td>Years Obturator Worn</td>
<td>Years Obturator Worn</td>
</tr>
<tr>
<td>Range: 2.0-4.5</td>
<td>Range: 3.8-11.3</td>
<td>Range: 1.1-8.2+</td>
</tr>
<tr>
<td>Mean : 2.9</td>
<td>Mean : 6.10</td>
<td>Mean : 3.5</td>
</tr>
</tbody>
</table>

Lateral Reductions

<table>
<thead>
<tr>
<th>Lateral Reductions</th>
<th>Lateral Reductions</th>
<th>*Lateral Reductions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Range: 3.0-31.0 mm</td>
<td>Range: 3.5-27.0 mm</td>
<td>Range: 0-18.5 mm</td>
</tr>
<tr>
<td>Mean : 20.0 mm</td>
<td>Mean : 13.28 mm</td>
<td>Mean : 6.9 mm</td>
</tr>
</tbody>
</table>

A-P Reductions

<table>
<thead>
<tr>
<th>A-P Reductions</th>
<th>*A-P Reductions</th>
<th>**A-P Reductions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Range: 2.0-7.0 mm</td>
<td>Range: 0-5.5 mm</td>
<td>Range: 0-8.0 mm</td>
</tr>
<tr>
<td>Mean : 4.5 mm</td>
<td>Mean : 2.7 mm</td>
<td>Mean : 3.5 mm</td>
</tr>
</tbody>
</table>

*1 patient had no reductions
**4 patients had no reductions
Information regarding voice quality is presented in Table 3. The majority of patients' vocal quality was judged to be "within normal limits". However, in one subgroup, those in which the obturator was subsequently replaced by a pharyngeal flap, 3 individuals did not attain "normal" voice quality following surgery.

Table 3
Voice Quality Of 25 Obturator Patients

<table>
<thead>
<tr>
<th>Patient Status</th>
<th>&quot;Within Normal Limits&quot;</th>
<th>&quot;Hypernasal&quot;</th>
<th>&quot;Hyponasal&quot;</th>
<th>&quot;Mixed Hyper-Hyponasal&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Obturator In Mouth</td>
<td>10</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Obturator Removed</td>
<td>4</td>
<td></td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Obturator Replaced By Pharyngeal Flap</td>
<td>4</td>
<td></td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>18</td>
<td>3</td>
<td>3</td>
<td>1</td>
</tr>
</tbody>
</table>

*"Hyponasality" noted at last follow-up appointment was reported to be secondary to nasal stuffiness.
Chapter 5

DISCUSSION AND CONCLUSION

Medical files of 25 patients with structural VPI and subsequent enrollment in the OHSU Obturator Reduction Program were reviewed. Information was gathered pertaining to the following areas: (1) age obturator was initially fitted and subsequent amount of time spent in the program, (2) current obturator status (i.e. age of removal, surgical replacement, or continuing modifications), (3) names of surgeons who performed the ensuing secondary surgeries (i.e. pharyngeal flaps), (4) number of changes and amount of lateral obturator reductions in millimeters, (5) number of changes and amount of anterior-posterior obturator reductions in millimeters, (6) judgement of vocal quality (i.e. "within normal limits", "hyponasal", "hyponasal", or "mixed hyper-hyponasal"), and (7) the occurrence of obturator treatment with or without simultaneous speech therapy.

Even though every attempt was made to obtain complete data in all of these areas, one limitation of a retrospective study such as this is that the information gained is often secondhand in nature. Thus, structured, consistent control of when and how each patient was treated was not available, and statistical analysis of the results obtained was not pursued. Still, a high degree of consistency and reliability does exist in this data from the standpoint that all 25 patients were seen by one of two dentists and one of two speech pathologists who have all been involved in the Obturator Reduction Program for 15 to 24 years.
Although not all areas of data were complete, all of the 25 patients maintained relatively consistent participation in the program. In two cases, families were noted to be inconsistent with follow-up appointments, one due to financial difficulties, and the other family which moved out of state for a period of time. One young patient was also noted to have "considerable difficulty" adjusting to the obturator and subsequently underwent secondary flap surgery at seven years of age.

An attempt was also made initially to see how many of these patients received speech therapy during their participation in the Obturator Reduction Program. However, with only general references made to this area in the files, one could not distinguish the extent of services, nor whether intervention pertained to assistance with sounds relating to air pressure difficulties, distortions, or habitual substitutions. Consequently, this area was not included for analysis.

Another important factor to keep in mind while reviewing these results is that approximately half of the patients are still actively undergoing modifications of their obturators. While some patients have been in the program for up to eight years, others began participating just a little over a year ago with only one reduction made since that time. The data presented here will thus be subject to change over time. Some patients currently wearing obturators will likely continue to do so until their obturators are subsequently replaced by surgical means, while others may develop sufficient velopharyngeal competency resulting in removal of their obturators. Therefore, the information offered herein must not be taken out of context. The intent is to describe the current status of 25 VPI patients fitted with obturators at OHSU, and not to make success/failure claims regarding the general usage of obturators.
Even though direct comparison of these results with other Obturator Programs which may employ different procedures, teams, and standards in their employment of obturators is not advocated, there are at least two studies which share similar background with this study, and thus do warrant some further comparison.

Blakeley, Adams, & Schindler in 1960, followed by Weiss in 1971, reviewed numerous cases of VPI involved with the OHSU Obturator Reduction Program. Several results of this present study are in close agreement with those found by Blakeley et al. (1960) and Weiss (1971). For instance, 20% of the patients in this study have had their obturators reduced out of their mouths while maintaining normal voice quality, a figure which is in close keeping with Blakeley's et al. (1960) research finding of 19% and Weiss (1971) at 16%. The amount of time this 20% wore an obturator ranged from two years to four years, five months, which parallels the range of 18 months to three years described by Weiss (1971). Of the remaining 80% of the patients, all were able to tolerate at least some reduction in obturator size, another phenomenon jointly noted by both Blakeley et al. (1960) and Weiss (1971). Commonality between studies also exists in that successful reduction and removal of an obturator did not correlate with any particular type of VPI.

In addition to noting the percentage of patients in which obturators have been successfully reduced out, a second glance at Table 3 reveals additional important information. As earlier noted by Blakeley (1984), a primary goal of the Obturator Reduction Program is to eliminate nasal emission and hypernasality. Of the 25 patients here reviewed, 18 of the patients in this program have achieved and maintained voice quality "within normal limits" as judged by one of the two speech pathologists.
involved in the program. Of the 13 patients who are currently wearing obturators, 10 are described as having voice quality "within normal limits". Of the seven patients whose obturators have been replaced by pharyngeal flaps, four are said to have "normal" voice quality, two are "hyponasal", and one patient is "mixed hyper-hyponasal". Once again however, due to the nature of this study, it is not possible to affirm the reliability and validity of these judgements. In addition, while all seven patients received the same type of secondary surgery, four different surgeons performed the various surgeries which may in part account for the range of results.

In many respects, the results of this study support an observation made by Weiss in 1971:

Even though most of our obturator patients have been successful in achieving the potential for normal articulation and vocal quality and in most instances the pharyngeal segments have been reduced somewhat, the majority of them eventually require pharyngoplasty (p. 292).

To many parents, patients, and professionals, this last statement will undoubtedly seem discouraging. If, after investing their time (often involving several years), effort, and money, the bottom line in many cases will be the eventual recommendation of secondary surgery, where is the payoff, the feeling of success and accomplishment, the benefits for having chosen to participate in an Obturator Reduction Program? Wouldn't it have been easier just to have done secondary surgery in the first place and avoided the complexities of obturation?

This paper has not reviewed the outcome of patients who underwent secondary surgery apart from participation in an Obturation Reduction Program, so statistics are not available with which to compare the after-
math of these two groups. In general however, a few observations have been made while doing research for this paper which are relevant to this issue.

Not all cases of cleft palate involve VPI. Some patients, following primary surgical repair of the palate, do develop adequate velopharyngeal competency for speech. Other individuals appear to achieve adequate functioning until they experience a growth spurt, such as during adolescence, resulting in a velopharyngeal gap which may continue to increase over time. Depending on the magnitude of change, concerns may be raised regarding the treatment of the VPI. Results of surgery at this time may be disrupted by additional growth. On the more conservative side however, employment of an obturator will likely reestablish normal oral air pressure for speech. Obturation will also allow room for future modifications whether they be enlargements or reductions as a means of maintaining velopharyngeal competency. Subsequent modifications of pharyngoplasties are also possible, but compared with obturators they cannot be carried out to the same extent or with the same ease.

Still other individuals may present VPI as early as two or three years of age as the speech sounds are developing. In young children such as these, anatomical and physiological development is rapidly changing. If secondary surgical intervention is performed to manage the VPI at this time, it may not prove to be adequate for the child in another six to twelve months time. In contrast, as suggested by Shelton and Lloyd (1963), use of an obturator allows for anatomical and physiological development to continue without interference while providing simulation of oral air pressure necessary for the development of speech sounds. And, as previously cited in this paper, obturators have been successfully worn by
young children and are readily amenable to changes warranted by the growing child.

The reader is again cautioned to bear in mind that physical management of VPI need not create professional conflicts regarding the "best" mode of treatment. What is of importance is to realize that obturators offer a more conservative and modifiable, though temporary, approach in the management of VPI, and in some cases appear to assist in successful correction of the insufficiency. Neither surgical intervention nor obturation can guarantee permanent establishment of adequate velopharyngeal functioning for speech purposes, but as noted by Blakeley (1964):

> It is proposed that both a speech prosthesis and a pharyngeal flap may be compatible, at different times, in the same patient and that the assets of each may be utilized (p. 198).

In conclusion, it is the opinion of this writer that the Obturator Reduction Program being conducted at the OHSU does offer a viable approach to the treatment of VPI. The team members offer high quality clinical expertise and dedication in the care and management of their patients. They also continue to be actively involved in ongoing research in this area, gathering and sharing their information with others via symposiums, written articles, and informal discussions. Still, as reflected by Schneider & Shprintzen's survey of 1980, speech prostheses are not in vogue as a treatment option in cases of VPI, at least not by the majority of professionals in the speech and language community. But as evidenced by this paper, the utilization of speech prostheses does have a lot to offer individuals with VPI, and it is time our profession shed its trepidation regarding their use and continued to support further research into this area.
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