A COMPARATIVE ANALYSIS OF NASILITY IN CLEFT PALATE PATIENTS WEARING SPEECH APPLIANCES AS OPPOSED TO CLEFT PALATE PATIENTS WITH SURGICAL REPAIR

Thesis for the Degree of M. A.

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by

C. Milan Gruehr

AN ABSTRACT OF A THESIS

Submitted to
Michigan State University
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The purpose of this study was to correlate nasal resonance in surgically and prosthetically repaired cleft palate subjects.

The subjects were selected by the following criteria: that they were at least nine years of age, with an I.Q. of 70 or more; only a slight hearing loss was permitted in the speech range.

Twenty four subjects (12 surgical and 12 prosthetic) were chosen and matched as to chronological age, type of cleft, estimated width of cleft, presence or absence of tonsils and adenoids and any hearing loss existing at the time of examination. No fistulas were present.

A phonendoscope, a type of stethoscope, was used to determine the presence or absence of nasality and/or nasal emission. The isolated sounds tested included: ɑ, æ, eɪ, i, aɪ, o, ʊ, ʌ, ɔ, t, d, k, and g.

There were often great individual differences between the subjects in each group, but the average presence of nasality in the sounds as arithmetically computed was not significantly different between the two groups, the difference on the sounds being 6.4 percent in favor of prosthesis.

This, because of the sample, was not considered to be a statistically significant difference.

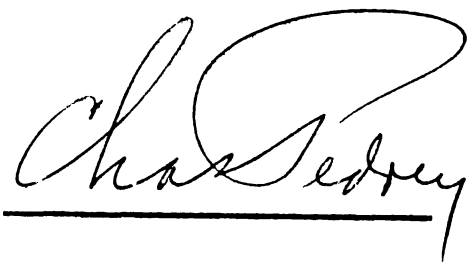
The six prosthetic cases having received no surgery showed only a 4 percent favor over their surgical mates.

Neither group experienced a special success or failure in the production of any sound with the exception of **1**. In this case the prosthetically repaired subjects produced the sound 25.1 percent more successfully than the surgically repaired cases.

The study showed that the back vowels were the most difficult for both groups to produce without nasality.

Time seems to favor the prosthetically repaired group. Those who had their devices longer seemed more successful with their speech. If this improvement continued, the, as yet, relatively insignificant differential of 6 percent might widen significantly.

This study reinforces the theory that there is no single answer for all cleft palate patients; each case must be treated individually.

Approved: 

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The writer is grateful to Dr. Robert West and Dr. William Behl at Brooklyn College for consultation and guidance in the design of this study. She also wishes to thank Dr. Kenneth Adisman and the Mount Sinai Hospital Cleft Palate Center for their assistance and cooperation in gathering the data. Special gratitude goes to Dr. Charles Pedrey at MSU for constant encouragement and guidance in the critical examination of this manuscript. Without the support of these people it would have been impossible to complete this study.

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INTRODUCTION

One of the primary speech goals of cleft palate subjects is the ability to express themselves in such a way that others will understand what they are saying.

For many years, research has been carried out to determine the most beneficial age for repairing cleft palates in order to obtain the best speech production. One argument which has been presented, advocating later repair, is the need for complete maturation of the palate and velopharyngeal cavity before surgery. An obturator would be used until this time. The question arises as to whether this will deter the formation of good speech habits and exercises, and seriously affect the speech of the subjects during early childhood.

Nature of the Problem

The purpose of this study is to compare the presence of nasality in some isolated vowel and pressure sound produced by cleft palate cases using obturators, with the presence of nasality in the same isolated sounds produced by cleft palate cases with completed surgical repair.

The cases fitting the specific prosthetic and surgical categories were found at Mount Sinai Hospital in New York City.

One hundred cases were screened from the clinic, from

which fifty subjects were chosen and only twelve in each category were selected and paired for the study. The remainder were exempted from this study because they did not meet all the necessary qualifications. Both groups were equated and matched as closely as possible.

Each case was recalled individually to the clinic and tested with regard to nasal resonance. The isolated sounds used were selected because they involved only the tongue and palate (alveolar ridge) for articulation. A phonendoscope was used to determine the presence or absence of nasal resonance and/or a nasal snort.

After the results had been recorded, the data was correlated in percentages. Each subject received an individual rating, the groups were rated collectively, and the sounds were classified from the easiest for the person with a cleft palate to make, to the most difficult.

The general results showed that there is no significant difference in the presence or absence of nasality between these two groups. Therefore, the effectiveness of the methods used for repair must be individually determined.

The author of this paper also suggest some interesting interpretations, observations and limitations of this study as well as suggestions for further research in the area.

This research is concerned with the nasality and articulation of the cleft palate patient; therefore, all types of cleft palate cases have been used.

CHAPTER I

HISTORY OF THE PROBLEM

A survey of background material reveals that there is experimental evidence correlating the degree of nasality of the cleft palate speaker with the extent of his velopharyngeal opening. Related to the sufficiency of the velopharyngeal valve are resonance distortion, articulatory ability and the understandibility of speech.[1] These factors are all associated with the contraction of the posterior and lateral pharyngeal muscles and the raising and backward movement of the palate or levator palati muscles.

The speech disorders resulting from cleft palate and cleft lip vary greatly after closure. The subject may display any one, or combination of the following:

1. An unacceptable speech pattern
2. Excessive nasality
3. Muffled vocal quality

Any of these may result in inaccurate sound production.

Physical findings in early repaired cases may cause limitations of growth. Some of these would be:

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[1]Kenneth R. Bzoch, "A Study of the Speech of a Group of Pre-School Cleft Palate Children," Cleft Palate Bulletin, Vol. IX, No. 1, (Jan. 1959), p. 2.

1. Tightness of soft palate in the antero-posterior direction, or in the lateral direction
2. Lack of tissue in both directions
3. Lack of mobility, and scarring

Two or more of these conditions combine to prevent adequate velopharyngeal closure. This inability to effect a satisfactory or adequate closure results in the nasal snort, or escapage of air on sounds requiring intra-oral air pressure through the nose. "Nasal escape and nasal articulation are chief hazards when primary repair of the palate is unsuccessful."[2] Some cleft palate subjects show almost no upward movement of the velum, due to surgical damage.[3] Dr. McKenzie Buck suggests that "surgical injury may account for extensive upward movement of the velum."[4] Many pathologists recognize the hypothesis that a significant degree of nasality results from morphologic involvement in the speech structures, particularly the velum.[5]

Whenever surgical damage results in partial or complete destruction of antagonistic muscle action,

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[2]Margaret C.L. Greene, "Speech analysis of 263 Cleft Palate Cases," Journal of Speech and Hearing Disorders, Vol. XXV, No. 1, (Feb. 1960), p. 44.

[3]McKenzie Buck, "Post-Operative Velo-Pharyngeal Movements in Cleft Palate Cases," JSHD, Vol. XIX, No. 3, (Sept. 1954), p. 288.

[4]Ibid., p. 288.

[5]Donald A. Hess, "Pitch Intensity and Cleft Palate Voice Quality," Journal of Speech and Hearing Research, Vol. II, No. 2, p. 113.

tending to oppose elevation of the velum, excessive upward movement of the velum may be expected.[6]

It has been suggested in recent investigations that retarded maxillary growth, frequently observed in surgical cases, may affect voice quality and articulation, and nasal emission may be dependent upon the height of the tongue.[7] Kantner reports that patients with unrepaired clefts in both hard and soft palates subjectively appear to have less nasality than some patients with functionally inadequate repaired clefts.[8]

Dr. Buck has given statistical evidence showing a very definite retardation and restriction of growth of the palate of the cleft palate subject, to an approximate 8.5 millimeter average difference.[9] Accounting for the difference in oral cavity size of cleft palate subjects to that of normal subjects, both appear to carry the tongue in the same relative position; but this causes the "high point" of the tongue of the cleft palate subject to be closer to the posterior

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[6]Buck, "Post Operative Velo-Pharyngeal Movements in Cleft Palate Cases," p. 288.

[7]S.X.C. Knobeloch and McKenzie Buck, "Velo-Pharyngeal Movements and Tongue Carriage During Speech in Adults with Unrepaired Complete Cleft Palates," CPB, (Jan. 1960), p. 122.

[8]Claude E. Kantner, "The Rationale of Blowing Exercises for Patients with Repaired Cleft Palates," JSHD, Vol. XII, No. 3, (Sept. 1947), p. 288.

[9]McKenzie Buck, "Facial Skeletal Measurements and Tongue Carriage in Subjects with Repaired Cleft Palates," JSHD, Vol. XVIII, No. 2, (July 1953), p. 126.

pharyngeal wall.[10] This may have something to do with the cleft palate subject's frequent use of the glottal stop for back tongue consonants.

Dr. Duane Spriestersbach reports an example of initial surgical repair which later proved inadequate:

> A $6\frac{1}{2}$ year old child with a repaired cleft of the hard and soft palate had 'speech within the range of normality.' $3\frac{1}{2}$ years later the child had developed a 'definite quality of hypernasality.' One of the sources of the difficulty appeared to be that the velum was no longer making contact with the posterior pharyngeal wall. What had appeared to be a highly successful operation with respect to function was not to be so considered some three years later.[11]

This emphasizes the point that the size and shape of the nasopharyngeal closure is not static.

Some authorities feel that the adenoidal tissue in some patients may approximate a closure of the nasal port, as may Passavant's Bar.[12] Others feel that Passavant's Bar is not serviceable for functional closure because of its position.[13]

It is a difficult task for a clinician to make judgements of nasality. Other deviations must be taken into account. They may be:

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[10] Ibid., pp. 128-129.

[11] Duane C. Spriestersbach, "Criteria for Establishing the Need for a Speech Appliance," JSHD, Vol. XXI, No. 3, (Sept. 1956), p. 366.

[12] Buck, "Post-Operative Velo-Pharyngeal Movement in Cleft Palate Cases," p. 293, and Robert F. Hagerty et. al., "Posterior Pharyngeal Wall Movement in Normals," JSHR, Vol I, No. 3, (Sept. 1954), p. 209.

[13] Hagerty, et. al., p. 209.

1. Typical articulation errors; for example, nasalization of fricatives and slighting of plosives.
2. Variation in pitch patterns which **detract** from the overall effectiveness of speech.

Judgements of the severity of nasality show a close relationship to the defectiveness of articulation of consonant sounds, the effectiveness and also the general intelligibility of speech.[14]

As misarticulation increases, so does the difficulty in intelligibility.[15] There is also a positive correlation between consonant articulatory errors and ratings of nasality.[16] This appears to advance the theory that reduction of nasality is not accomplished merely by attention to the pharyngeal closure alone.

Cleft palate children seem to be generally retarded in articulation skills; they have less difficulty with voiced

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[14]Betty Jane McWilliams, "Some Components in the Intelligence of the Speech of 43 Cleft Palate Adults," CPB, Vol. VI, No. 2, p. 7; Rolland J. Van Hattum, "Articulation and Nasality in Cleft Palate Speakers," JSHR, Vol. VI, No. 4, (Dec. 1958), p. 387; Donald A. Hess, "Pitch Intensity and Cleft Palate Voice Quality," JSHR, Vol. II, No. 2, (June 1959), p. 113; Duane C. Spriestersbach, "Assessing Nasal Quality in Cleft Palate Speech of Children," JSHD, Vol. XX, No. 3, (Sept. 1955), p. 270.

[15]Betty Jane McWilliams, "Some Factors in the Intelligibility of Cleft Palate Speech," JSHD, Vol. XXIX, No. 4, (Dec. 1954), p. 526.

[16]Ibid., p. 527.

rather than voiceless consonants.[17] Least difficulty is had with the nasal components: m, n, ŋ, and the h, and j; the greatest difficulty is had with the fricative consonants s, z, θ, tʃ , and ʒ.[18]

Another study demonstrates no language retardation, but a retarded amount of verbal output and vocabulary usage.[19] This implies that there was a general retardation in vocabulary usage and length of response, which is characteristic of almost any child with a speech handicap.

Many subjects who entertain early cleft palate repair are often subjected to later operations due to breakdown of the repair. In the treatment of cleft palate, the prevention of scarring and contracture is of primary importance.[20] Breakdowns of surgery are primarily due to an insufficient suture or a shortage of the blood supply causing inadequate growth in relation to the rest of the area.

Prosthetics also have their shortcomings. Constant alteration of an obturator is necessary for satisfactory fitting, and then it is difficult for a patient to manage

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[17]Duane C. Spriestersbach, Frederic L. Darley, Verna Rouse, "Articulation of a Group of Children With Cleft Lips and Palates," JSHD, Vol. XXI, No. 4, (Dec. 1956), p. 445.

[18]Ibid., p. 445.

[19]Duane C. Spriestersbach, Frederic L. Darley, Hughlett L. Morris, "Language Skills in Children with Cleft Palates," JSHR, Vol. I, No. 3, (Sept. 1958), p. 284.

[20]T. Pomfret Kilner, "The Management of the Patient with Cleft Lip and/or Palate," American Journal of Surgery, Vol. XCV, (1958), p. 204.

without the appliance while these corrections are being made. Another very important factor in the use of prosthetics is the condition of the teeth. A patient is able to wear an appliance only when his teeth are stable enough to hold it in place. As cleft palate patients progress in years, their teeth often are no longer capable of fulfilling this need. There is also the tendency to lose teeth at an earlier age due to the extra demands of the obturator. This would leave the subject with nothing to depend upon and could have extremely regressive psychological results.

There are two main types of obturators: the fixed and the hinge. The fixed type is the continuation of a denture and depends on its shape for a functional seal.[21] The hinge type is movable and depends not only on its shape, but on the musculature to carry it and occlude the desired parts.[22] Each offers many basic inadequacies. The appliance, in order to fulfill its requirements must:

1. Contact Passavant's Pad during function
2. Perform contact with the dorsum of the tongue for (k) and (g)
3. Assure ample clearance laterally to prevent pain during extreme movements of the head
4. Allow for pharyngeal muscle movement in

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[21] R.K. Miles, "Obturators for Congenital Cleft Palate," Australian Journal of Dentistry, Vol. XXVII, (1955), p. 18.

[22] Ibid., p. 18.

swallowing.[23]

Other criteria must be observed in recommending a speech appliance. The patient's psychological attitude toward an obturator is important. What is done in one specific field must be related to the total care and progress; " . . . an atmosphere of multiprofessional collaboration must exist."[24]

These criteria would be:

1. The health aspects of the patients or subject
2. Local facilities for proper maintenance of an obturator
3. Facial factors including: the quantity and quality of tissue bordering the cleft; the width of the cleft; the length of the soft palate; the configuration of the nasopharynx; and myofunction analysis.[25]

> Effective diagnosis (for a prosthesis) includes: an evaluation of the teeth, width of the cleft, size of upper and lower arches, carriage of the tongue, effectiveness of the closure of the velopharyngeal port, activity of the jaws and lips, the general loudness of speech, (level) and articulation errors.[26]

Speech factors are also concerned with this diagnosis. The subject would be examined for general intelligibility,

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[23] Ibid., pp. 23-24.

[24] Duane C. Spriestersbach, "Criteria for Establishing the Need for a Speech Appliance," p. 370.

[25] Ibid., p. 370.

[26] Ibid., p. 367.

functional or maturational difficulties other than the cleft, and the specific sounds which are misused. The speech therapist would need to determine where this fault lay; in the cleft, in the alignment of the dental arches, in the condition of the anterior teeth, or in the size and shape of the palatal vault.[27]

Up to this time, there has been no study specifically comparing the speech of the surgically repaired cleft palate cases with the prosthetically closed palate cases. Studies do exist showing the improvement of these cases before and after prosthesis, as well as surgical successes. The question then arises as to which of these closures, surgical or prosthetic, results in the more satisfactory speech ability, if one can be determined.

Dr. Richard C. Webster of Brookline, Massachusetts started a clinic in 1956 in which he practices both surgery and prosthetics in closing the palate of the young cleft palate patient. Because of the delayed effects of later surgery and the balking of parents and schools toward this approach, he is using a threeflap surgical operation to repair the soft palate, and an obturator for closure of the hard palate until the hard palate reaches a point near maturation.[28]

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[27]Spriestersbach, "Criteria for Establishing the Need for a Speech Appliance," p. 370.

[28]Richard C. Webster, "Pharyngeal Flap Staphylorrhaphy and Speech Aid as Means of Avoiding Maxillofacial Growth Abnormalities in Patients with Cleft Palate," American Journal of Surgery, Vol. 96, (1958), p. 822.

Because this project has been in effect for only four years, no results are reported thus far in the study.

Which is the best method? Speech improvement is the goal of both. Many believe that surgery is the only answer while others feel that early surgery will fail as growth and development take place. Recently there have been more advocates of prosthetic closure with later surgery.

> We do not believe that a delay of two or three years makes enough difference in this respect to outweigh the greater likelihood of failure of operation, technical difficulty, interference with growth and higher mortality at an earlier age.[29]

The present study was made to help investigate the problem further as to which is the best method for the best speech results: Prosthetics or Surgery?

Definition of Terms

It is necessary at this time to clarify some of the terms used in this study.

> Cleft lip and cleft palate are deformities of tissue disposition, specifically of disjunction and inadequacy (occasionally overdeveloped) of the tissues of the lip, nose, jaw, hard palate, velum, pharynx, and cranial base.[30]

The varieties of cleft palate are placed in four categories for the purpose of this study.

Type I involves a cleft of the soft palate.

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[29]Robert H. Ivy, "Indications for the Use of Surgery or Prosthesis in Cleft Palate Patients," CPB, Vol. II, No. 1, (Jan. 1952), p. 6.

[30]Herbert Koepp-Baker, "Pathomorphology of Cleft Palate and Cleft Lip," Handbook of Speech Pathology, ed. Lee Travis, (New York: Appleton Century Croft, 1957), p. 570.

Type II involves a cleft of the soft and hard palate.

Type III is a unilateral complete cleft which involves a cleft of the soft palate, hard palate, alveolar ridge, and usually the lip.

Type IV is a bilateral complete cleft, which involves a cleft of the soft palate, hard palate, alveolar ridge, and double lip.

> Nasality is the quality of speech sounds when the nasal cavity is used as a resonator; especially when there is too much nasal resonance.[31]

Nasal speech is the name given to those cleft palate cases who appear acoustically to have this resonant quality carry over in all of their speech sounds to a considerable degree. This occurs when the nasopharyngeal port is definitely open.[32]

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[31]Kenneth Scott Wood, "Terminology and Nomenclature," Handbook of Speech Pathology, p. 60.

[32]R. West, M. Ansberry, and A. Carr, The Rehabilitation of Speech, (3rd ed., New York: Harper and Brothers Pub., 1957), p. 180.

CHAPTER II

TESTS, METHODS, PROCEDURES

Selection of Subjects

This study examined correlations in the nasal resonance of cleft palate subjects using obturators as compared with those with completed surgical repair. This was effected by screening the medical records of 100 subjects and evaluating fifty subjects at Mount Sinai Hospital in New York City. Twenty five of these cases were using obturators and twenty five had completed surgical repair. Of this group, only twelve pairs met the specific requirements set up by the author of this paper.

Subjects were selected by the following criteria: that they were at least nine years of age, with an Intelligence Quotient of at least 70 or better and that they had no more than a slight hearing loss (30-35 decibels).

No subject was included in this study unless his medical record stated the type of cleft repaired, the number of operations performed on the palate, the age at initial repair, the age at completion of closure, the presence or absence of tonsils and adenoids or the age at which they were removed, the age of obturator insertion, and its period of time in use.

The selected subjects were then controlled and matched as closely as possible as to their chronological age and maturation, the type of cleft and estimated width of cleft as judged by the examiner from the medical records and reports, the presence or absence of tonsils and adenoids because of their related importance in naso-pharyngeal closure, and any hearing loss which may have existed at the time of examination.

These criteria were considered the most important for comparison because of their individual effects upon the subjects.

The sex of the subjects as well as the Intelligence Quotient were also given some consideration because they are related to the degree of motivation often found in handicapped people.

The number of operations was incidental except in those prosthetically repaired cases where no surgery had been attempted. This group was later compared in isolation from the remainder of the group to determine whether freedom of growth without damaged tissue influenced the production of sound without nasality.

The age of completed closure with the present age was taken into consideration for it allowed the period of time the patient had practical usage of his speech mechanism without an opening to his nasal cavity.

All subjects who had a fistula present in the palate were barred from the study. All cases had received speech

therapy sometime during their life.

No consideration was given to the age of satisfactory completion of cleft lip repair, for while this is important cosmetically and psychologically, it was not related directly to the articulation of the sounds used for testing.

Administration of Tests

After all case history data was compiled, those subjects filling the above stated requirements were recalled to the clinic for examinations. There were twelve cases with prostheses and twelve cases with surgically repaired completed closures.[33] The consonant pressure sounds k, g, t, and d, were selected because they required only a tongue-palate (alveolar ridge) contact and did not involve other articulatory mechanisms. The vowel sounds ɑ, æ, i, o, ʊ, ʌ, ɔ, and the diphthongs eɪ and aɪ were also tested in isolation for nasality. Each vowel sound was repeated three times after the examiner introduced the sound. The pressure consonants were also repeated three times and any nasal resonance was recorded after each sound. A phonendoscope, a type of stethescope, was used to determine the presence or absence of nasal resonance, and/or nasal emission.

A phonendoscope is "A stethoscope which, by means of two parallel plates of guttapercha (the dried milky juice of Palaquium gutta employed in the manufacture of splints and

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[33]The greatest majority of these cleft palate cases did not receive surgery at Mt. Sinai Hospital, but were operated upon before entering this clinic.

various other purposes), . . . intensifies the ausculatatory sounds."[34] The stethoscope, originally designed by Laennec "for aid in hearing the respiratory and cardiac sounds in the chest, is now modified in various ways and employed in mediate auscultation of any of the vascular or other sounds in the body. It consists essentially of two self retaining ear pieces connected with a single bell."[35]

This instrument has a diaphragm which amplifies and transmits sound which comes in the binaural receiver of the phonendoscope. The diaphragm is held about one inch from the nares. Any nasal resonance or air emission could be immediately collected and detected. If nasal resonance was present or air escaped through the nasal passages, it was transmitted to the ear as a strong vibration in the ear of the examiner. If nasal resonance or air emission was present in any of the vowel or consonant sounds, it was recorded positively; if not, it was recorded negatively. No effort was made to rate the amount of nasality; either it was present or absent.

After the testing evaluation was completed, it was analyzed in the following way.

Of the thirteen sounds tested (100 percent), each subject received a score of two percentage figures related to the number of sounds in which nasality was present and to the

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[34] Stedman's Medical Dictionary, (ed.) Norman Burke Taylor, (Baltimore, Williams and Wilkins Co., 1953), 18th revised edition, p. 1055.

[35] Ibid., p. 1299.

number of sounds where it was absent. The individual percentages for each subject were then scaled and a mean figure for each group was determined.

Those patients using prostheses and never having received any surgical assistance were isolated from the rest of the study and compared separately with their surgical "mates." This was for the suggested purpose of determining whether the lack of surgery had any influence on the production of the isolated sounds, and if so, was it due to stronger muscular action, growth and development without the presence or interference of scar tissue.

The vowel and consonant sounds were also compared separately to determine any difference in the presence or absence of nasal resonance on any of the individual sounds. The sounds were then rated and recorded in the order of the frequency of the occurrence of nasality.

CHAPTER III

RESULTS AND CONCLUSIONS

The medical records and test results of fifty cleft palate patients have been obtained and analyzed in an effort to determine whether the presence of nasality was more frequent in those cases with surgically closed palates or those cases with prosthetically closed palates. The findings of all the subjects were analyzed and matched as closely as possible as to age, type of cleft, presence of tonsils and adenoids, or age of their removal, audiograms, and age of completed closure.

Of this number, only twelve pairs, (twenty four subjects) were selected for the study. The remainder were eliminated because they did not meet the necessary qualifications or criteria for this study.

There often were great individual differences between the subjects within each group, but the average presence of nasality in the sounds as arithmetically computed was not significantly different between the two groups.

The average absence of nasality on the group of isolated vowel and consonant sounds tested in the surgically repaired group was 61.5 percent; the average presence of nasality on these sounds was 38.5 percent.

The average absence of nasality on the group of isolated vowel and consonant sounds tested in the prosthetically repaired group was 67.9 percent; the average presence of nasality on these sounds was 32.1 percent. Therefore, the average difference between the two groups was only 6.4 percent in favor of prosthesis. This, because of the size of the sample was not considered to be a statistically significant difference.

The six prosthetically repaired cases who had received no surgery before or after prosthetic correction also showed no significant average mean difference in the presence or absence of nasality as compared to the specifically related surgically closed cases. The average mean difference was 4 percent in favor of prosthesis.

The average period of time palatal closure had been completed for the prosthetic cases was one year ten months; five of these cases had had their obturators for only two to three months. Those with obturators for longer periods of time were progressively better with only two exceptions. This did not pertain to the surgically repaired cases. The average period of time palatal closure had been complete for the surgically repaired cases was six years three months. Only one of these cases had had completed closure for less than a year. This gave the surgically repaired group's closure an average period of four years five months longer than those using prostheses.

It should be noted that the average age of the

prosthetically repaired cases was thirteen years five months. The average age of the surgically repaired cases was fourteen years one month. This shows that the subjects chosen for the study had reached the palatal maturation period and that little growth will occur beyond this time. Breakdown due to inadequate growth in relation to the rest of the area is not likely.

In the surgically repaired group there were seven cases with Type III clefts (all of the left side), three cases with Type II clefts, and one case in each of Type I and Type IV clefts.

In the prosthetic group, there were three cases of Type IV clefts, three cases of Type III clefts, (all of the left side), six cases of Type II clefts; none of Type I were represented.

The types of clefts were correlated between the two groups as closely as possible. The examiner was unable to find more than one subject with a Type IV cleft in the surgically repaired group with a satisfactorily closed palate. Fistulas were present in all cases. Therefore, a Type III cleft corresponding as closely as possible in width and length was "paired" with a Type IV cleft in the prosthetically repaired group.

The selection of the subjects in the two groups was done with considerable consideration given to the width of cleft and the length of the soft palate. This was done by the judgement of the examiner with the aid of pictures and

medical reports on the individual patients.

Tables I and II in the appendices show a relation of pairs of all persons included in this study. Relations indicated are: sex, age, intelligence, type of cleft, age of tonsil and adenoidal removal, number of surgical operations, age of initial closure and age of completed closure.

Table III and IV in the appendices employ the same key, the numbering system of the case, and the presence or absence of nasality for each individual vowel and consonant sound. This is to allow for comparisons between tables.

Neither group experienced any special success or failure in the production of any sound, with the exception of (i). In that case, the prosthetically repaired group produced the sound 25.1 percent more successfully than the surgically repaired group.

Seven of the remaining twelve sounds were produced more frequently without nasality by the prosthetically repaired group, but not significantly better from an overall standpoint. These sounds were (ɑ), (eɪ), (o), (ʊ), (d), (k), and (g). Those sounds produced by the surgically repaired group with less nasality were (æ), (aɪ), and (t), but not significantly better. The sounds (ɔ), and (ʌ) had equal ratings. The progression of the sounds produced with the least amount of nasal resonance to the greatest amount of nasal resonance present in the surgically repaired group was: (aɪ), (ɔ), (æ), (ʌ), (ɑ), (k), (o), (t), (g), (eɪ), (ʊ), (d), (i), as shown in Table V.

The progression of these sounds produced with the least amount of nasal resonance to the greatest amount of nasal resonance present in the prosthetically repaired cases was: (ɔ), (ɑ) , (ʌ) , (aɪ), (æ) , (k) , (o) , (g) , (eɪ), (t), (d), (i), (ʊ) as shown in Table VI.

Thus, it appeared in this study, that although there was no significant mean difference between these two groups, there was a tendency towards a lesser incidence of nasality in isolated sounds among the prosthetically repaired group.

CHAPTER IV

SUMMARY AND INTERPRETATIONS

Findings Obtained

A study of the medical histories and test results of isolated vowel and consonant sounds produced by patients with surgically repaired and prosthetically repaired cleft palates was made with the intention of determining which group produced these sounds most frequently without nasal resonance or nasal emission of air.

There was no significant difference between the groups as to the presence or absence of nasality. There was a tendency for subjects with prosthetically repaired cleft palates to have less nasality than the subjects with surgically repaired cleft palates.

It should be noted here, that although there was no significant difference in the presence or absence of nasality in these two groups, the prosthetically repaired group did have three cases without any nasality on the sounds tested, while there were no such instances in the surgically repaired group.

The study showed that the back vowels were most difficult for both groups to produce without nasality. There was no significant difference between the groups in the presence

or absence of nasality on any of the test sounds except the (i) which had more satisfactory results from the prosthetic group.

Interpretations and Areas of Further Research

Many of the surgical cases originally examined were omitted from this study due to fistulas still present in the hard or soft palate. At least one of these surgically repaired subjects was rejected for each one accepted from the original fifty subjects.

A few of the prosthetic cases were also omitted because of necessary obturator adjustments due to poor fittings.

These observations appear to substantiate the belief that surgery is not always entirely satisfactory and completely successful. The adjustment period may be a weakness when using obturators. Sometimes these patients are without their appliances for periods of several weeks.

Because of the time span of four-years-five-months average difference between the cases with completed surgical closure and the cases with completed prosthetic closure, and the almost equal ability to produce sounds with or without nasality, this writer feels that surgery would be more satisfactory if complete closure could be assured. But, due to the inconsistent results of the surgical cases examined for complete closure this does not appear to be the case. Another means of assuring more permanent correction would be earlier appliance adjustment.

Time seems to favor the prosthetically repaired group. Those who had their devices longer seemed more successful with their speech. If this improvement continued, the, as yet, relatively insignificant differential of 6 percent might widen significantly.

It would be an interesting study to follow these groups over certain time periods, and note any variations or improvements in the speech results. The surgically repaired cases had already had a longer period of time to develop the correct usage of speech musculatures and articulatory mechanisms than those cases using speech appliances.

It must be noted that the majority of the subjects used in this study were clinic patients and that there were few private cases. Social histories showed large families and low incomes. Some families were living on welfare. This may influence a lack of ambition and motivation within the individual. Another suggestion for further study might be to compare clinical cases with private cases to see if greater social motivation would bring about more satisfactory results; or if there is any variation in the speech abilities of these two groups.

This study has reinforced the theory observed by all cleft palate teams. There is no single answer for all cleft palate cases. Each case must be treated individually. Attention must be given to all phases of the organic and personal problems of the patient, and diagnoses and corrective methods which are considered best for that particular patient must be

carried out. This makes it more difficult for anyone to insist on a privately considered, personally favored method of treating cleft palate patients.

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APPENDIX

TABLE 1

TABLE OF SURGICALLY REPAIRED CASES USED IN STUDY

Subject No.	Present Age	Sex	I.Q.	Age of operation Type of Cleft	Age of operation T&A	Hearing	Number of Operations	*Age at Initial Closure	*Age at Compl. Closure
1									
1	23	F	Av.	III	0	0	1	23	23
2	18	F	Av.	I	4	1-2	1	17	17
3	16	M	Av.	III	0	0	13	2	12
4	16	M	Av.	III	6	0	3	1½	3
5	14	M	Av.	III	0	1	5	4mo.	7
6	13	F	Av.	III	4	1	2	2	7
7	14	M	L.Av.	III	4	1-2	2	2½	3
8	14	M	Av.	III	14	0	4	18mo.	2
9	10	F	Av.	II	0	1-2	2	3	5
10	11	M	Av.	IV	0	0	9	1½	9
11	10	F	L.Av.	II	0	0	1	3	3
12	9	M	H.Av.	II	0	0	3	1½	8

*Age of the subject at time of closures.

Hearing Key - 0-sound threshold below 20 db in speech range
1-sound threshold between 20-30 db
1-2-sound threshold between 20-35 db

I.Q. Key - Av. - 90-110
L.Av. - 70-90
H.Av. - Above 110

Note: The case numbering system is identical throughout the tables to allow for comparison.

TABLE 2

TABLE OF PROSTHETICALLY REPAIRED CASES USED IN STUDY

Number	Present Age	Sex	I.Q.	Age of operation Type of Cleft	Age of operation T&A	Hearing	Number of Operations	*Age at Initial Closure	*Age at Compl. Closure
1	20	F	L.Av.	II	0	0	0	15	18
2	18	F	L.Av.	II	0	1-2	6	18mo.	17
3	17	F	Av.	IV	0	0	2	4	13
4	17	F	L.Av.	III	4	0	1	5	14
5	14	M	L.Av.	II	0	H.F.2	0	0	7
6	13	F	L.Av.	III	8	0	1	4	11
7	17	M	Av.	IV	0	1	1	2	13
8	11	M	Av.	IV	4	0	1	2	10
9	12	F	L.Av.	II	0	1-2	1	12	12
10	10	F	Av.	III	0	0	0	7	7
11	10	M	Av.	II	0	1-2	0	5	10
12	9	F	L.Av.	II	0	0	0	9	9

*Age of the subject at the time of closure.

Hearing Key- 0- sound threshold below 20 db in speech range
1- sound threshold between 20-30 db.
1-2- sound threshold between 20-35 db.

I.Q. Key - Av. 90-110
L.Av. 70-90
H.Av. above 110

TABLE 3

NASALITY CHART FOR CASES USING OBTURATORS

	ɑ	æ	eɪ	i	aɪ	o	ʊ	ʌ	ɔ	t	d	k	g	− Absence Percentage	+ Presence Percentage
1	−	−	−	−	−	−	+	−	−	+	+	−	−	76.9	23.1
2	−	−	+	+	−	+	+	−	−	+	+	+	+	38.5	61.5
3	−	−	−	−	−	−	−	−	−	−	−	−	−	100.0	0.0
4	−	−	−	−	−	−	−	−	−	−	−	−	−	100.0	0.0
5	−	−	−	−	−	−	−	−	−	−	−	−	−	100.0	0.0
6	−	−	+	+	−	−	+	−	−	+	+	+	+	46.2	53.8
7	−	+	+	+	−	−	+	−	−	+	+	−	−	53.8	46.2
8	−	+	+	+	−	+	+	−	−	−	−	−	−	61.5	38.5
9	−	−	−	+	−	+	+	−	−	+	+	−	−	61.5	38.5
10	−	−	+	+	−	−	−	−	−	+	+	−	+	61.5	38.5
11	+	−	+	+	+	+	+	+	−	−	+	−	+	30.8	69.2
12	−	−	−	+	−	−	+	−	−	−	−	−	−	84.6	65.4

− absence of nasality
+ presence of nasality

TABLE 4

NASALITY CHART FOR CASES WITH COMPLETED SURGICAL REPAIR

	ɑ	æ	eɪ	i	aɪ	o	ʊ	ʌ	ɔ	t	d	k	g	- Absence Percentage	+ Presence Percentage
1	-	-	+	+	-	-	+	-	-	+	+	+	-	53.8	46.2
2	+	-	+	+	-	+	+	-	-	-	+	-	+	46.2	53.8
3	-	-	+	+	-	+	+	-	-	-	+	-	+	53.8	46.2
4	-	-	-	-	-	-	+	+	-	-	-	-	-	84.6	15.4
5	-	-	+	+	-	-	+	-	-	-	+	-	+	61.5	38.5
6	-	-	-	+	-	+	+	-	-	+	-	+	+	53.8	46.2
7	-	-	+	+	-	+	+	-	-	+	+	+	+	38.5	61.5
8	+	-	-	+	-	+	+	-	-	-	+	-	-	61.5	38.5
9	-	-	+	+	-	-	+	-	-	-	+	-	-	69.2	30.8
10	+	+	+	+	-	-	-	-	-	+	+	-	+	53.8	46.2
11	-	-	+	+	-	-	-	-	-	+	+	-	-	69.2	30.8
12	-	-	-	+	-	-	-	-	-	-	-	-	-	92.3	7.7

- absence of nasality
+ presence of nasality

TABLE 5

Order of sounds produced from least amount of nasality present to the greatest amount of nasality in the subjects tested.

Surgery	aɪ	ɔ	æ	ʌ	ɑ	k	o	t	g	eɪ	u	d	i
-	100%	100%	91.7%	91.7%	75%	75%	58.3%	58.3%	50%	33.4%	25%	25%	8.3%
+	0	0	8.3%	8.3%	25%	25%	41.7%	41.7%	50%	66.6%	75%	75%	91.7%

- absence of nasal resonance or nasal omission
+ presence of nasal resonance or nasal emission

TABLE 6

Order of sounds produced from least amount of nasality present to the greatest amount of nasality in the subjects tested.

Prosthetic	ɔ	ɑ	ʌ	aɪ	æ	k	o	g	eɪ	t	d	i	u
-	100%	91.7%	91.7%	91.7%	83.4%	83.4%	66.6%	66.6%	50%	50%	41.7%	33.4%	33.4%
+	0	8.3%	8.3%	8.3%	16.6%	16.6%	33.4%	33.4%	50%	50%	58.3%	66.6%	66.6%

- absence of nasal resonance or nasal omission
+ presence of nasal resonance or nasal emission.

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