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Psychological, Orthodontic, and Prosthetic Approaches in Rehabilitation of the Cleft Palate Patient*

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PSYCHOLOGICAL APPROACHES

Each year in the Commonwealth of Pennsylvania approximately three hundred children are born with the physical abnormality, cleft lip and/or cleft palate. This incidence of occurrence is second only to that for club foot in order of congenital anomalies.

Lack of sufficient general information about the cleft palate condition written specifically for laymen places the individual under a "social shadow" from which it may be difficult for him to emerge.

The Pennsylvania Department of Health requires the attending physician to note on the child's birth certificate any physical defect. This information is channeled through the Bureau of Vital Statistics and the Bureau of Maternal and Child Welfare to the Cleft Palate Section. The family's physician is then supplied with material regarding the disposition of his patient to an approved cleft palate clinic for diagnosis and treatment planning according to a group decision. Parents of the patient need early advice and guidance.

Some surgeons suggest closing the cleft lip before the baby is discharged from the hospital, their main reason being the reduction of psychological trauma to the parents.

We feel it is vitally important to counsel the parents in the hospital regarding etiological factors of cleft conditions to eliminate guilt feelings or the blaming of each other for the baby's defect.

Following the initial surgery to the lip, the patient is recalled to

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the Clinic periodically for medical, dental and speech evaluations. The psychologist continues the parent education program, emphasizing the importance of maintaining good parent-child relationships. An overprotecting mother can be a greater hazard to the patient than the deformity itself.

Our parent education program, which starts with the initial visit to the hospital and then transfers to our official auxiliary, offers peace of mind to the parents. Discussions regarding the development and growth of the "normal" child prepare the parents for acceptance of and cooperation in a projected, multidisciplined treatment program.

It is desirable to follow through the long-range program with periodic testing and evaluation of both patient and parent. Educational service, particularly the psychological program, is of great importance in aiding the parents and the patient. The psychologist is in a position to be a coordinator or "go-between" for the family and the clinical program.

Audiometry, dental x-rays, cineradiographic studies of the patient and sound spectrographic tracings are valuable visual aids to diagnosis for the rehabilitation team regarding treatment planning, and also offer information to the patient by depicting his speech problem. The psychology of "seeing is believing" must not be taken too lightly. The patient should be reasonably informed about his physical limitations prior to the initiation of treatment. This leaves no doubt as to why the suggested method of treatment is best for him.

A physical defect such as cleft palate does not necessarily constitute a social handicap. Although the defect will always be present, the patient must learn to accept the things which cannot be changed, must be encouraged to change the things that can be changed, and must be taught to know the difference.

It is a basic assumption of this clinic that if a person is going to be able to do anything at all, he should be able to realize that he looks like a normal person, and he should be able to speak easily and clearly. Nothing else is so necessary to his social and educational development. It is difficult to give first importance to any one of the other problems with which people with cleft palates and/or facial deformities must contend.

ORTHODONTIC APPROACHES

In recent years, there have appeared in the literature articles emphasizing the importance of using a team approach in treatment planning for the cleft palate child. Teamwork has been defined by Webster as "work done by a number of associates all subordinating

personal prominence to the efficiency of the whole." That is our objective.

The orthodontist, as a member of this team, is vitally interested in the future growth and development of the cleft palate infant's face and jaws, and in the functions relating to these structures. He will naturally share the responsibility in treatment planning very early in the child's life.

With the onset of the eruption of the primary teeth, the cleft palate child should be observed periodically by the orthodontist. Radiographs, photographs, impressions for study models, and cephalometric roentgenograms are taken for serial studies as an aid in determining the patterns of growth and facial proportions. It is during this early observation period that deviations from the normal might be noted in the development of the maxilla, resulting in a crossbite on the affected side. Here early orthodontic therapy is advisable to expand the maxilla and prevent a more serious deformity from occurring later on. However, there are some factors that might contraindicate orthodontic therapy. The first of these is the need for socially acceptable speech. An orthodontic program that would in any way interfere with speech therapy following prosthesis or surgery, or both, would be contraindicated until socially acceptable speech is learned. This is of particular importance in the preschool child, since it is necessary that he be able to enter school with his own age level.

Another important consideration is the distance the patient lives from an orthodontist. Because an orthodontic program requires frequent visits over extended periods of time, this travel issue is extremely important. Some patients flatly refuse orthodontic therapy because of the travel involved. It must also be remembered that there are certain orthodontists who will not treat cleft palate patients.

Cleft palate patients who have had multiple surgical procedures may prove to be poor orthodontic cases because of the extreme amount of scar tissue involved. This is frequently found in the type III and type IV cases. The amount of bone loss due to the cleft is also a possible contraindication. This particularly affects teeth approximating the line of the cleft. Supernumerary or missing teeth are usually a hazard to the successful orthodontic approach.

It has been noted that when surgical closure of the palate is indicated, this procedure is generally delayed until the child reaches 18 to 24 months of age. This delay permits the maxillary parts to develop in the lateral directions within normal relationship to mandibular growth. This is especially true in those patients who present no cleft of the lip, for they have no muscular imbalance between the dental

arches and the malocclusion that might appear is due to other hereditary or environmental factors.

The most challenging problems to the orthodontist appear in the unilateral and bilateral cleft lip and cleft palate patients. Following the surgical closure of the lip in the unilateral cleft lip patient, there is often an imbalance of the labial musculature which acts as a restraining force on alveolar processes. Expansion of the alveolar segment on the side of the cleft at an early age is indicated to aid in the future growth of the maxilla as well as to facilitate the normal positioning of the permanent teeth. Quite often, however, this cannot be done because the patient may not be seen by the orthodontist until the permanent dentition stage. Careful evaluation should be given before deciding on a treatment plan that might involve several years of orthodontic therapy. One should consult with a prosthodontist to determine if permanent replacements might be more advisable for the teeth approximating the line of the cleft. This is especially true for the child who demonstrates a lack of velopharyngeal closure, and therefore will need an obturator as part of the rehabilitation program.

The bilateral cleft lip and cleft palate patient presents the most challenging problem in treatment planning, not only to the orthodontist but also to the rest of the team. Invariably a noticeable muscular tension is evident following the surgical closure of the lip. This produces a restraining effect on the normal development of the alveolar segments. Radiographic examination often reveals missing dental units in the line of the cleft, supernumerary or malformed teeth in the premaxilla. This does not present a good prognosis for extensive tooth movement in the area. Since the premaxilla has no bony union with the maxillary segments, it is often positioned anteriorly, and both maxillary segments rotate medially behind it. Some investigators have suggested early expansion in these cases, with the eventual repositioning of the premaxilla in mind. It has been our experience that although limited improvement might be gained for the patient, a relapse is inevitable. The orthodontist should consult with the surgeon to determine if further surgical revision of the lip will improve muscular balance. He should also consult with the prosthodontist to determine what type of replacement will be considered for the missing dental units and whether the movable premaxilla will be a problem in gaining a good cosmetic result.

Many times a lengthy orthodontic program can be eliminated by the surgical removal, or reduction, of the premaxilla, allowing the prosthodontist to restore the anterior segment by a prosthesis (Figs. 1 and 2). Recognizing our limitations, the orthodontic management of the bilateral cleft lip and cleft palate should not be undertaken lightly.

PROSTHETIC APPROACHES

Contrary to popular opinion, dental prosthetic speech aids are not new. Dentists have been fabricating obturators for openings in the hard palate since the early 16th century. Like his predecessors, the prosthodontist of today is vitally interested in the treatment program for the individual with an oral cleft. The decision regarding a prosthesis is based upon the patient's needs, his motivation for improvement, and his availability for the suggested treatment. Each portion of the

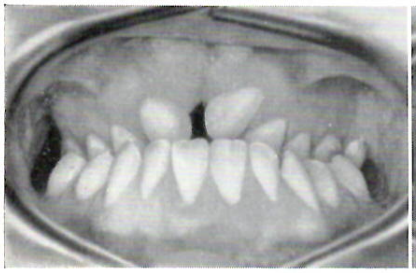

Fig. 1

Fig. 2

Fig. 1. Patient age 21, with bilateral cleft lip and palate. The maxilla is constricted, there is no occlusion, the soft palate is short, and speech is defective.
Fig. 2. Prosthetic appliance in place after removal of right and left cuspids and full coverage of posterior teeth.

prosthesis must be artistically designed to suit the individual in relation to his oral-facial balance, masticatory function and speech.

Diagnostic Procedures

Every patient with an oral cleft should be examined by a group of surgical, medical, dental, and speech specialists. Full consideration should be given to the following: (1) type and width of cleft; (2) length, thickness and mobility of the soft palate; (3) perforations remaining in the hard and soft palate area and labial sulcus after surgery; (4) postpharyngeal and lateral wall activity; (5) loose premaxilla; (6) number of missing teeth; (7) malformed and malposed teeth; (8) partially erupted teeth; (9) teeth in line of cleft; (10) constricted maxilla; and (11) condition of tonsils and adenoids. The patient's articulation, voice quality, hearing acuity and general health must also be considered.

Roentgenograms of the teeth and jaws, study models and photographs should be obtained at the earliest possible age. A cineradiographic study of soft palate function is helpful for evaluation of velopharyngeal closure in postoperative cases (Fig. 3). Where this is

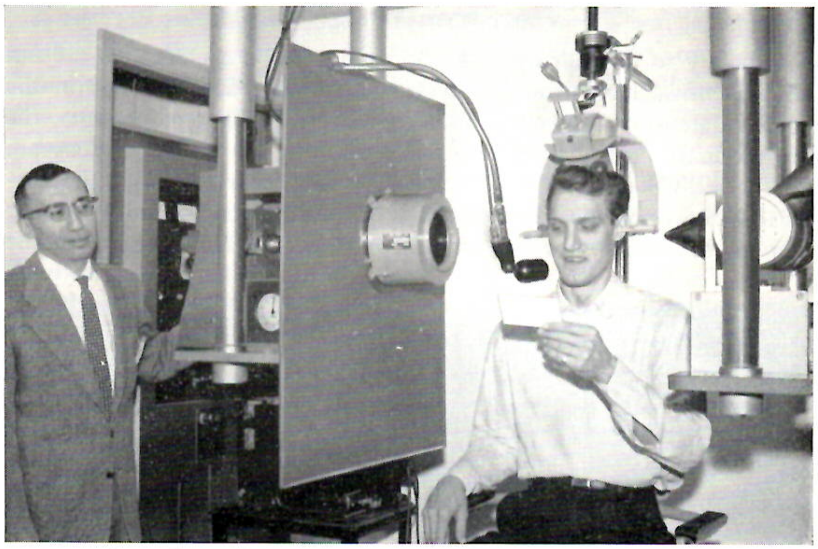

Fig. 3. Cineradiographic unit is used to study dynamics of soft palate, tongue, and throat wall function during speech, and is a valuable aid to surgical techniques or prosthetic speech-bulb location; diagnosis and treatment planning.

Fig. 4. Visible speech is analyzed by the Sound Spectrograph, which charts the speech pattern, frequency vs. time, related to intensity. Each vowel and consonant display can be compared to normal, thus showing the weakness of the patient's pattern of speech.

not available, a series of cephalometric roentgenograms can be of great assistance. Sound spectographic analysis of speech is another aid to determine the patient's need, as well as a method for comparative study of speech changes (Fig. 4).

Treatment Planning

Integration and coordination of specialized services has proved to be the best method of rehabilitating the individual with a cleft palate. Prosthetic or orthodontic treatment is required whenever the cleft involves the alveolar bone, as in the patient with a complete unilateral or bilateral cleft.

Indications for Prosthetic Appliances

Prosthetic speech appliances are recommended as primary treatment when surgery is not indicated for those patients with a cleft palate (Fig. 5*A*). Such an appliance is also indicated in postoperative cases when the soft palate is short or immobile, causing nasal speech owing to inadequate velopharyngeal closure. Other factors favoring the use of a prosthesis are the presence of multiple perforations in the hard and soft palate, paralysis of the soft palate, partial or complete anodontia, blood dyscrasias, partially erupted teeth, and a prominent or loose premaxilla.

The prosthesis is also used for patients who have lost part or all of the soft or hard palate owing to malignant or benign lesions. In our clinic we have treated patients with prostheses who had had perforations in the soft palate as a result of gummatous lesions. In some cleft palate conditions in children, the surgeon would rather postpone the palatal surgery until the patient has physically matured or reached a certain age level. In these situations, a temporary prosthesis might be used to help the patient with his speech. We have found that the speech bulb has a tendency to stimulate muscle action of the pharyngeal walls. Consequently, the patient who has worn a temporary prosthesis while waiting for surgery increases his chances to develop adequate velopharyngeal closure following surgical repair of the soft palate.

Requirements of a Prosthesis

Esthetics. Some cleft palate patients require replacement of upper anterior teeth and plumping of the lip. Therefore the arrangement of the teeth and carving of the gingival margins should be artistically balanced to fit the individual's facial features.

Occlusion. If the patient requires any posterior tooth replacement, the prosthodontist should keep in mind all the requisites for functional and balanced occlusion.

Partial Dentures. Partial denture prostheses should be designed to utilize all the remaining teeth for clasping in order to distribute the burden.

Crowns. When indicated, the remaining posterior teeth should be crowned.

Material. Material from which the prosthesis is made should be easy to alter and repair.

Weight. Weight of the prosthesis should be kept to a minimum.

Coverage. The partial denture prosthesis should cover the hard palate and the cleft area of the soft palate. Proper positioning of the pharyngeal section of the prosthesis in relation to the nasopharyngeal walls is essential.

Stability. The prosthesis should remain static during phonation, mastication, and deglutition.

Retention. A complete denture prosthesis should utilize the anatomic undercut in the nasal cavity for retention.

Secretion. The superior portion of the prosthesis should be sloped laterally to eliminate the collection of nasal secretions.

Space Relationship. The inferior portion of the prosthesis should be slightly concave to allow for freedom of tongue movement. The palatal portion of the prosthesis should be properly vaulted. In cases where a great deal of scar tissue remains in the hard palate area, the thickness of the artificial material should be kept to a minimum.

Impression Techniques

Preliminary Impression. A stock tray of adequate dimension is selected. A hydrocolloid impression material is used to take the preliminary impression. This impression should be carefully checked for accuracy over the cleft and perforation areas. The impression is poured with stone, and an acrylic tailor-made tray is constructed over the preliminary cast and perforated.

Final Impression. The tailor-made tray is tried in the mouth and is properly adjusted. Perforations in the labial sulcus and hard palate area are packed with petrolatum gauze to prevent the escape of impression material into the nasal cavity and its severe undercut areas.

A non-operated cleft of the soft and hard palate does not require any packing. A hydrocolloid or a rubber-base impression material is used to take the final impression. Two major precautions should be observed in impression taking: (1) do not overpack the tray with

impression material; (2) do not use too much force. Excessive amounts of material and pressure have a tendency to force the material into the nasal cavity and undercut areas and cause difficulty in removing the impression in one piece. The impression is poured immediately, using proper techniques to obtain an accurate cast.

Establishing Vertical Dimension and Centric Relation

All the usual steps for establishing an accurate vertical dimension and centric relation are followed on patients who require complete or partial denture prosthesis. In some cleft palate patients, it might be necessary to add wrought wire clasps to the occlusion rims to increase their retention in the mouth. In completely edentulous persons, occlusion rims are constructed over a well fitted acrylic base.

Master casts are properly surveyed and designed by the prosthodontist. Consideration should be given to all the problems involved. In patients with severely constricted maxillae and normal mandibular arches, where the orthodontist feels treatment is not indicated, the teeth are set up outside the remaining teeth so as to give the patient proper occlusion. Partially erupted teeth which are out of occlusion should be crowned and covered by acrylic resin to prevent food from being trapped in these areas.

Construction of the Appliance

The prosthetic speech appliance is constructed in three sections. The design of the anterior portion is similar to that of a normal partial or complete denture (Fig. 5*B*). In most cases the number of retainers is increased. It is then worn by the patient for at least one week. The length of the adjustment period depends on the ability of the patient to adapt to this part. Construction of the middle portion, tailpiece or velar section varies in operated and non-operated clefts.

1. In non-operated clefts with an upper prosthesis in position, the extent of the tailpiece over the margin of the cleft is marked on the posterior part of the appliance. The tailpiece extends posteriorly to the anterior of the uvula.

2. In operated cases with a short soft palate, which require a prosthesis, the position of the tailpiece is marked on the posterior margin of the prosthesis. The tailpiece extends 3 mm. behind the posterior margin of the soft palate.

In some patients for whom a prosthesis is indicated, we decide to redivide or excise a V-shaped segment from the soft palate to position

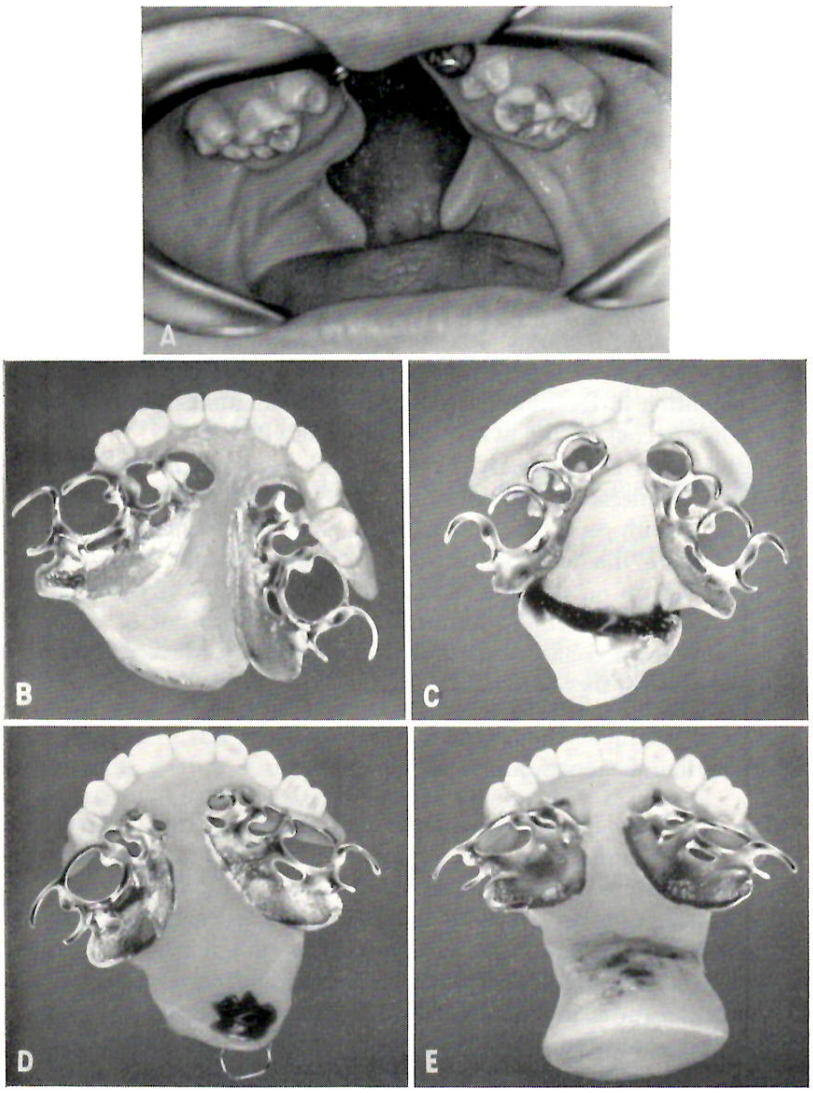

Fig. 5. See opposite page for legend.

the speech bulb in the proper area. When the speech bulb is positioned too far inferiorly, it has the following undesirable effects: (1) a tendency to be displaced by the dorsal portion of the tongue during tongue movements, (2) failure to relate to the normal area for velopharyngeal closure, and (3) a detrimental acoustical effect upon voice quality.

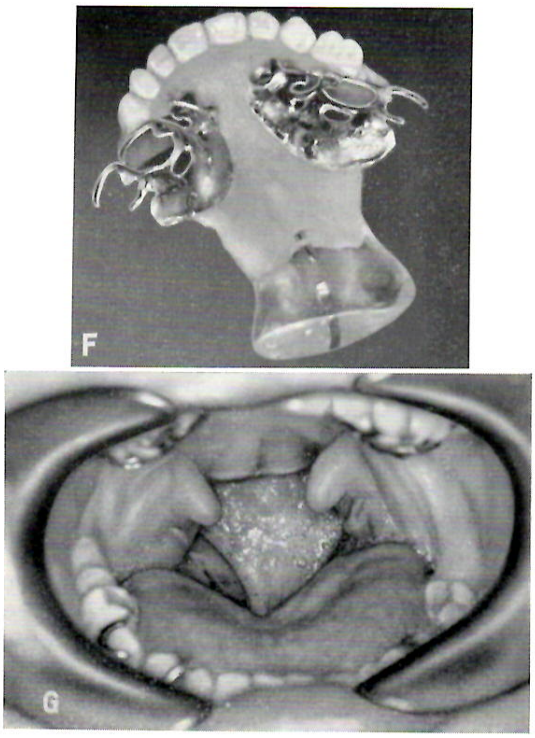

Fig. 5. Step-by-step procedure in construction of a prosthetic speech appliance for a patient age 12, with postoperative bilateral cleft lip and cleft palate. Premaxilla had been removed by the surgeon. *A*, View of the maxillary cleft. *B*, Anterior portion of the prosthetic speech appliance. *C*, Superior view of the prosthesis with attached baseplate tray to carry the impression material for impression of the medial portion. *D*, Wire loop attached to the medial section of the prosthesis to hold speech bulb impression material. *E*, Adaptol impression of the velopharyngeal area. *F*, Speech bulb processed in clear acrylic; half-round wire extending through anterior, medial and posterior segments of appliance for reinforcement. *G*, Prosthetic speech appliance in position.

Construction of Tailpiece. A piece of base plate of the required width and length, which acts as a tray, is securely attached to the posterior portion of the upper prosthesis with 2 mm. relief and is brought to the mouth for a check of proper extension (Fig. 5*C*). The upper portion of the tray is filled with zinc oxide impression paste and the appliance is inserted in the mouth. The patient is instructed to hold his head in a vertical position for one minute to prevent the escape of material into the nasopharynx. After one minute, the patient is instructed to swallow some water for the registration of soft palate muscular movement in the impression. After the material

is set, the prosthesis is removed from the mouth and is sent to the laboratory for processing of the tailpiece. In order to reduce the number of times the appliance has to be heat-cured, self-curing acrylic is used for this procedure. The finished tailpiece is inserted into the mouth, and the ejection of water stimulates the muscle movements along the lateral edge of the tailpiece. The action is carefully checked to avoid muscle pressure against the tailpiece, which might cause soreness. The patient is dismissed for one week for the tissues to adjust to this portion.

Construction of Speech Bulb. Two holes are drilled in the posterior part of the tailpiece. A piece of separating wire is drawn through the holes in such a manner that a loop is formed beyond the superior part of the tailpiece (Fig. 5*D*). The two ends of the wire are twisted together inferiorly and secured to the appliance by sticky wax. With the prosthesis in position, a 5×7 x-ray is taken to locate the position of the wire in relation to the anterior tubercle of the atlas bone. Green compound is added around the wire loop to reinforce the wire. The appliance is inserted into the mouth and the patient is asked to swallow some water. The wire should not contact the pharyngeal wall. Adaptol softened in water at 150° to 160° F. for 4 or 5 minutes, and added over the green compound, is then manipulated to an oval form and inserted into the mouth. Again the patient is instructed to swallow some water.

The prosthesis is reinserted a number of times, with Adaptol being gradually added to the speech bulb until a functional impression is made of the involved area (Fig. 5*E*). The patient is instructed to place his chin against his chest and move his head from side to side. In the rest position, he swallows water and converses to allow for muscle trimming of the impression material. An overextended bulb will be felt by the patient during these actions and during speech. Tinfoil is adapted over the bulb impression and another 5×7 x-ray is taken to check the position of the bulb in relation to the external tubercle of the atlas bone. The appliance is then sent to the laboratory for the heat-curing processing of the bulb and tailpiece (Fig. 5*F*).

For those individuals in whom the tissues of the posterior and lateral pharyngeal walls are very sensitive, producing a gag reflex, no attempt is made to obtain a functional impression for the speech bulb on the initial try. It is advisable to construct an underextended bulb, process it in self-curing acrylic, and let the patient become adjusted to it for two or three weeks. After the patient is accustomed to the undersized bulb, a final impression is taken simply by adding Adaptol to this portion. The final impression of the speech bulb is processed by heat-curing.

A length of 11-gauge half-round wire extends from the anterior part of the appliance to the speech bulb. This is incorporated into the appliance to prevent swallowing of the bulb in case of fracture of the tailpiece. The finished prosthetic speech appliance is inserted in the mouth and checked for the following: muscle adaptation to the speech bulb during swallowing and phonation; excessive pressure against the posterior and lateral walls of the pharynx; stability of the appliance during function; improvement of voice quality and articulation of speech.

Location of Speech Bulb. Cineradiographic studies of individuals with normal soft palate reveal that the soft palate contacts the pharyngeal wall over an extended area anterior and superior to the external tubercle of the atlas bone. These studies have never demonstrated that the so-called Passavant's pad exists in the normal individual, as suggested by many writers. However, we have noticed in some postoperated and nonoperated cases of cleft palate that postpharyngeal wall activity exists as a compensatory mechanism.

In patients with postpharyngeal wall activity, the speech bulb is positioned above the constricted muscle area. This speech bulb location eliminates undue muscle pressure against the bulb during muscle function. Muscle pressure against the speech bulb disturbs not only the retention of the appliance but also the entire arch and occlusion.

For patients who do not have postpharyngeal wall activity, the speech bulb is positioned anterior and superior to the external tubercle of the atlas bone. This speech bulb location corresponds to the normal area of velopharyngeal closure (Fig. 5*G*). Proper speech bulb location enhances the reduction of nasal resonance which is the most common speech problem for individuals with a cleft palate.

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