graphic motion picture films. The radiation hazard is very greatly reduced because the cineradiographic system utilizes the image intensifier.

The rapid movement of the soft palate during speech creates difficulty in extracting dynamic information from isolated static roentgenograms exposed at uncertain times during the speech exercise.[5] Cineradiography is a valuable adjunct in diagnosis and treatment evaluation of patients with cleft palate who require prosthetic speech appliances.

REFERENCES

1. Cooper, H. K.: Cinefluorography With Image Intensification as an Aid in Treatment Planning for Some Cleft Lip and/or Cleft Palate Cases, Am. J. Orthodontics **42**:815-826, 1956.
2. Mazaheri, M.: Prosthetic Treatment of Closed Vertical Dimension in the Cleft Palate Patient, J. Pros. Den. **11**:187-191, 1961.
3. Warren, D. W., Hofmann, F. A., and Miller, R. M.: A Study of Velopharyngeal Closure Using Cineradiography With Image Intensification (Abst.), J. D. Res. **40**:733-734, 1961.
4. Cooper, H. K., Long, R. E., Cooper, J. A., Mazaheri, M., and Millard, R. T.: Psychological, Orthodontic and Prosthetic Approaches in Rehabilitation of Cleft Palate Patient, D. Clin. N. America, pp. 381-393, 1961.
5. Hofmann, F. A.: Cineradiographic Data Reduction of Soft Palate Movement, *in* Prazansky, S., editor: Congenital Anomalies of the Face and Associated Structures, Springfield, Ill., 1961, Charles C Thomas, Publisher, pp. 337-344.

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PROSTHODONTICS IN CLEFT PALATE TREATMENT AND RESEARCH

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PROSTHODONTICS IN CLEFT PALATE TREATMENT AND RESEARCH

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AS OUR KNOWLEDGE AND EXPERIENCE in the cleft palate field increased, those of us responsible for providing prosthetic care recognized the importance of establishing a better prosthodontic concept and principle regarding treatment. In rendering these patients the best service, we should first follow all the rules and principles governing the fixed and removable partial denture prosthesis and should, secondly, remove any fear of causing harm because of existing anatomic, functional, and physiologic deviation.

DIAGNOSIS AND TREATMENT PLANNING

In treating oral-facial-speech handicapped people, the best results are achieved when the diagnosis and treatment are carried out by a group of clinicians who represent the various interested specialities, and who work together as a team rather than independently performing a series of procedures.

In the diagnosis and treatment planning, full consideration should be given to: (1) the type and width of the cleft; (2) the position and relation of the maxillary segments to each other in the unilateral and bilateral clefts; (3) the form and lateral and anteroposterior dimension of the maxillary arch; (4) the length, thickness, and mobility of the soft palate; (5) the perforations remaining in the hard and soft palate area and labial sulcus after surgery; (6) the posterior and lateral pharyngeal wall activities and the size of the nasopharynx; (7) a loose premaxilla; (8) the number of missing teeth; (9) malformed and malposed teeth; (10) partially erupted teeth; (11) teeth in the line of the cleft; (12) constricted maxillae; (13) the condition of the tonsils and adenoids, and (14) growth and development of the child. The speech articulation of the patient, his voice quality, hearing acuity, mental attitude, and general health also must be considered.

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*Chief of Dental Service.

Socially acceptable speech cannot be produced without creating a proper velopharyngeal valving action. Therefore, surgical closure of the palate without due consideration to the depth of the nasopharynx and the length and function of the velum during phonation cannot satisfy the objective. Better understanding of the nature of the cleft, anatomy, and the physiology of the area involved would eliminate many of these difficulties. The results of surgical treatment of cleft palates should be evaluated with the aid of cineradiographic studies[1] (Fig. 1), serial cephalometrics, maxillary and mandibular casts, face masks (Figs. 2-8), speech recordings made before and after surgery, sound spectrographic analysis, measurements indicating the nasal and oral pressure and flow, and speech and audiometric evaluations.

All members of the team should be thoroughly familiar with the problem at hand. Often the best result is not achieved when the knowledge of the specialists is not all-encompassing.[2]

The total habilitation and rehabilitation in the field of oral, facial, and speech handicapped is achieved only when the following objectives are kept in mind: (1) socially acceptable speech, (2) restoration of the masticating apparatus, (3) esthetic facial and dental harmony, and (4) psychologic adjustment of the patient to the condition.

To use a speech appliance simply as a last resort is poor procedure. Its use must be clearly indicated by the oral conditions. For example, the indications for a prosthesis are clearly defined for a patient with a series of unsuccessful palatal

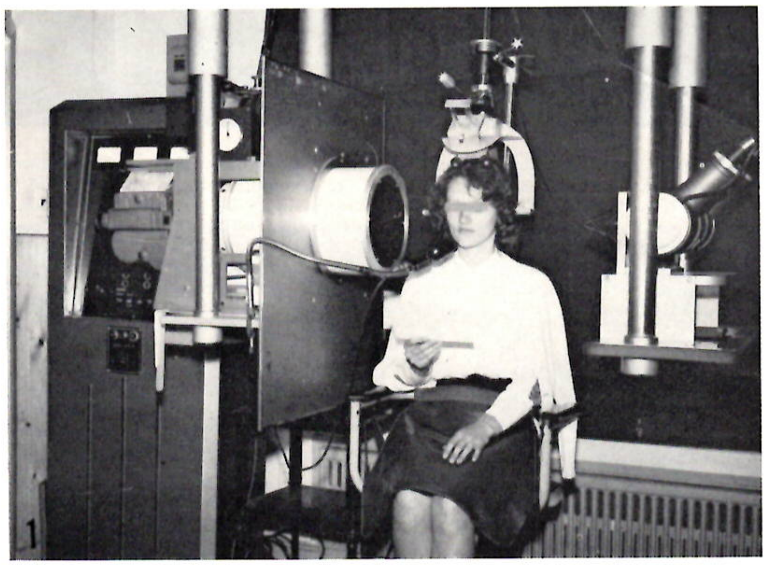


Fig. 1.—The cineradiographic unit records both roentgenographic motion pictures and the speech of the patient. This specially designed, ceiling-mounted apparatus supports the roentgen tube, cameras, radiation timer, and image intensifier. The intensifier reduces the radiation to the patient while increasing picture screen brilliance 3,600 times. The head holder is attached to the chair.

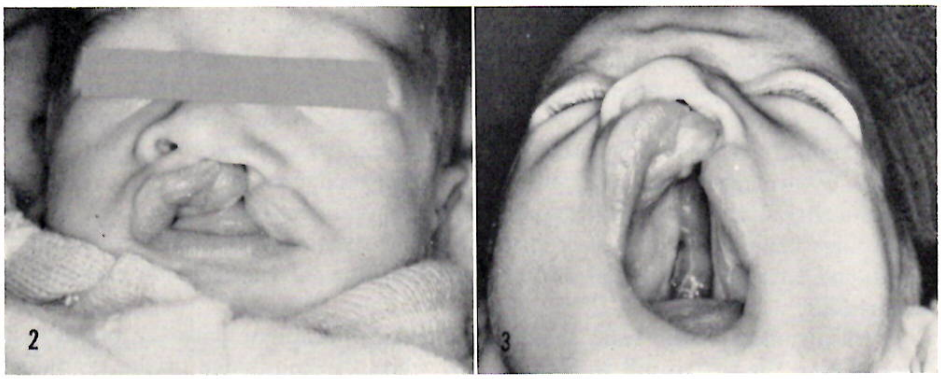


Fig. 2.—An infant with a complete unilateral cleft of the lip, soft and hard palate.
Fig. 3.—A complete unilateral cleft of the lip, soft and hard palate.

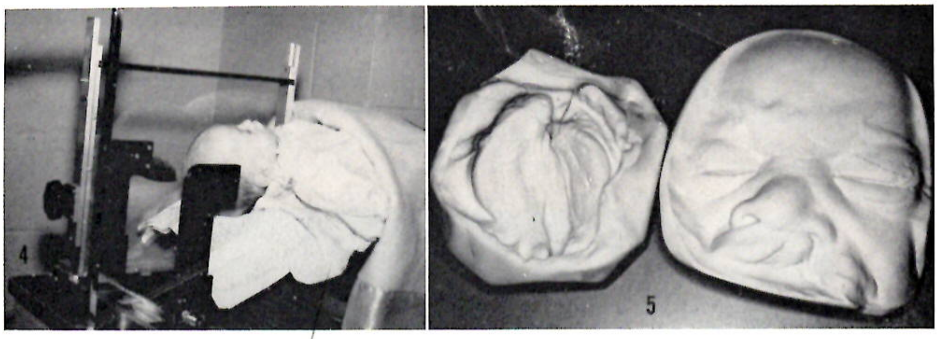


Fig. 4.—One to two teaspoons full of Nembutal elixir, determined by the patient's age and weight, is administered orally. Each teaspoon full of Nembutal elixir represents 15 mg. (¼ gr.) of Nembutal sodium. The child is held by the parents 15 to 30 minutes in a quiet, warm, and darkened room until the sleeping state is produced. The child then is placed on the infant cephalometric table for anteroposterior and lateral roentgenograms.[10]

Fig. 5.—Casts made from irreversible hydrocolloid impressions of the face and maxillary and mandibular regions. The impressions are made after the infant emerges from the sedation. The change in water temperature would reduce the gelation from 5 to 10 seconds.

operations. There is no magic in a prosthetic speech aid. However, there are some patients for whom a prosthesis seems to be the only means of improving the speech. In such situations it fills a definite need. A prosthetic speech aid should be used for palatal conditions where it is indicated, just as the pharyngeal flap operation should be used only where it is indicated.[1-3]

INDICATION OF PROSTHETIC SPEECH APPLIANCE FOR UNOPERATED PALATES

A surgical repair of a cleft palate is to be preferred to a speech aid prosthesis. However, there are some situations in which a prosthesis should be the choice of treatment. This choice should be dictated by the group charged with the habilitation of cleft palate patients. Some such situations are as follows:

1. *A Wide Cleft With a Deficient Soft Palate.*—Some clefts of this type do not lend themselves to a surgical repair by means of local flaps (Figs. 9-11). A prosthesis is preferable in these situations to the more time-consuming remote flaps. Many of the patients need a prosthesis to restore missing dental units, and the distant tissue only provides an adynamic mass.

2. *A Wide Cleft of the Hard Palate.*—In bilateral clefts, the vomer may be high and the cleft of the hard palate wide so that a surgical repair may produce a low vaulted palate. It may be possible to close the soft palate with the aid of local flaps and restore the hard palate with a prosthesis. A situation similar to that once advocated by Gillies and Fry is created, or the primary repair of the velum may create a more favorable spatial arrangement for subsequent surgery on the hard palate.

3. *Neuromuscular Deficit of the Soft Palate and Pharynx.*—The repair of the palate would not be conducive to the development of a good speech. It is diffi-

Fig. 6.—The postoperative results on the lip of the child at the age of 4 years and 2 months.

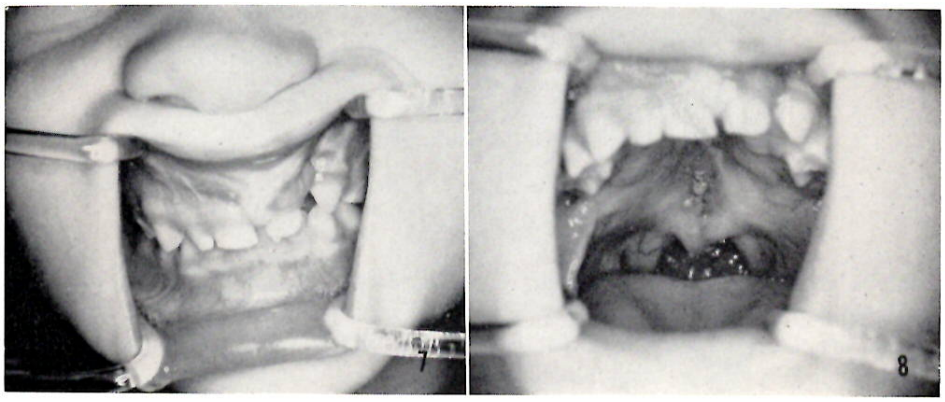


Fig. 7.—The occlusion.
Fig. 8.—The postoperative palate. After the continuity of the orbicularis oris muscle was restored, the premaxillary segment which was projected labially is molded into position, greatly reducing the gap between the segments.

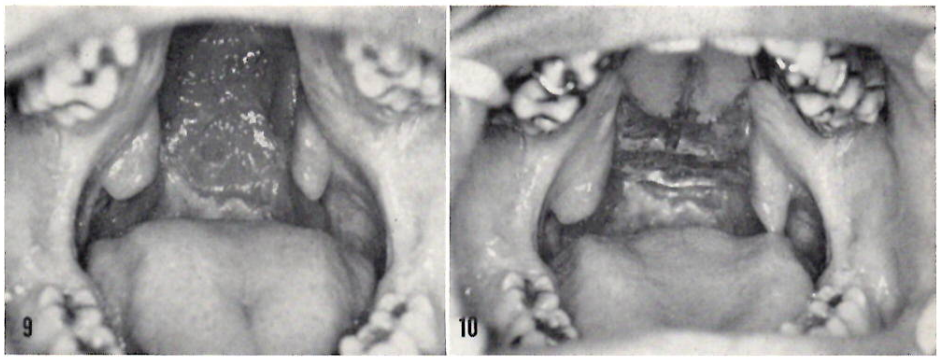


Fig. 9.—A wide cleft of the soft and hard palate with insufficient local tissue and absence of the vomer bone. A prosthesis is indicated.
Fig. 10.—The prosthesis is in position.

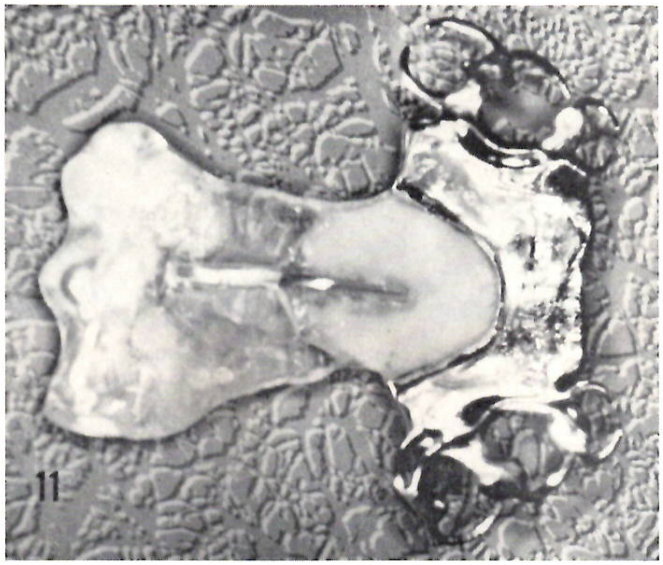


Fig. 11.—The prosthesis for the patient in Fig. 9 as seen from the tongue side.

cult to create and maintain a pharyngeal flap large enough to produce competent palatopharyngeal valving without obstructing the airway in the presence of a neurogenic deficiency of the critical muscles. A pharyngeal flap serves best when it is surrounded by a dynamic musculature. When this situation does not exist, the pharyngeal section of a speech-aid prosthesis may serve better to reduce nasality and nasal emission. The prosthesis can also act as a physical therapy modality, providing a resistive mass for the muscles to act against (Figs. 12-14). Should muscle function improve, definitive surgical measures can then be contemplated.

4. *Delayed Surgery.*—When surgery is delayed for medical reasons or when the surgeon prefers to repair the palate at a later age, the cleft palate may be temporarily closed with a speech aid prosthesis.

5. *Expansion Prosthesis to Improve Spatial Relations.*—An expansion prosthesis may be used to restore and maintain more normal spatial relations of the maxillary segments prior to surgery. The maxillary segments can be gradually separated by an expansion prosthesis to create a space for the premaxilla or to stabilize the parts in a normal position in association with an autogenous bone graft. The use of expansion or repositioning prosthesis, with or without bone grafting, should be done on selected cases. In the majority of the cleft lip and palate patients, the restoration of the anatomic continuity of the labial muscles would mold the segments into acceptable relationships to each other and to the mandible.[4]

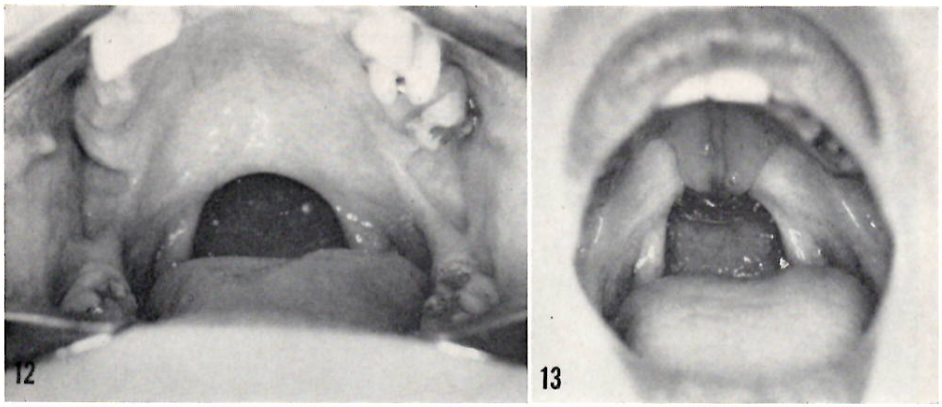


Fig. 12.—The prosthesis will serve this patient as a temporary physical modality to stimulate lateral and posterior pharyngeal wall activities before the palatal closure is attempted.
Fig. 13.—The prosthesis is in position.

Fig. 14.—The activity of the posterior and lateral pharyngeal walls has increased after 6 months of wearing the prosthesis. (Compare with Fig. 12.) This palate was operated upon 12 months after the insertion of the prosthesis with an excellent speech result.

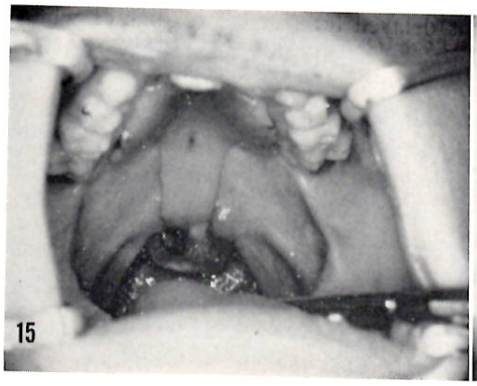
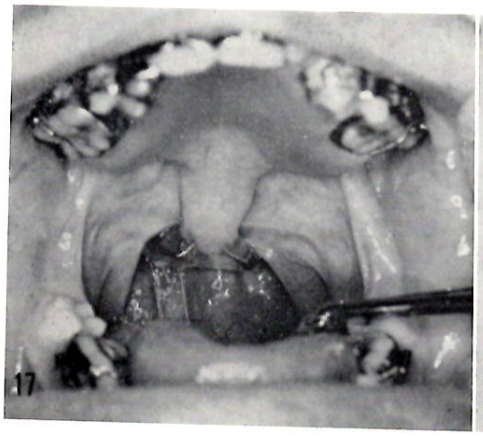


Fig. 15.—The prosthesis was used to stimulate posterior and lateral pharyngeal wall activity in this postoperative palate. The size of the pharyngeal section is gradually reduced and the treatment is continued until adequate velopharyngeal closure is achieved.

Fig. 16.—The palate shown in Fig. 15 without the prosthesis.



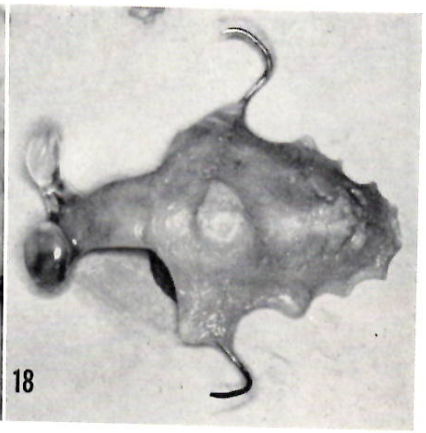


Fig. 17.—The prosthesis could be used to stimulate posterior and lateral pharyngeal wall activity at the sides of the pharyngeal flap. The stimulation should be done before the flap is inserted.

Fig. 18.—The palatal side of the prosthesis shown in Fig. 17.

6. *Combined Prosthesis and Orthodontic Appliance.*—An orthodontic appliance may be combined with a prosthesis to move malposed teeth into a more favorable alignment.

INDICATIONS FOR A PROSTHESIS IN OPERATED PALATES

1. *Incompetent Palatopharyngeal Mechanism.*—If the clinical and cineradiographic analyses suggest that the patient is near a functional closure, a prosthesis may serve as a physical therapy modality (Figs. 15-19). The pharyngeal section of the prosthesis is gradually reduced as muscle function improves, and the prosthesis is eventually discarded. When the patient presents a large velopharyngeal

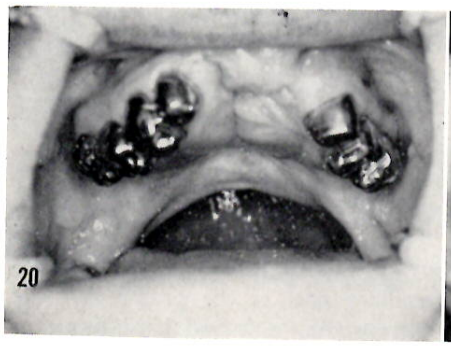
gap associated with a neurogenic deficiency, the speech-aid prosthesis should be considered as a permanent type of treatment.

2. *Surgical Failures.*—A prosthesis should be considered when a patient presents a palate which is low vaulted, heavily scarred, and contracted, or one which has a large perforation or multiple perforations (Figs. 20-23). Because of the surgical progress in the last 25 years, plastic surgeons today are not confronted with so many failures in cleft palate surgery. The trained surgeon can now predict with greater accuracy the possible success or failure of an operation and is inclined to avoid a likely failure if another alternative is available. Approximately 60 per cent of all cleft palate patients will need some type of prosthesis by the age of 30 years.[3]

CONTRAINDICATIONS TO A PROSTHESIS

1. *Feasibility of Surgical Repair.*—Only when a surgical closure of the cleft will produce an anatomic and functional repair is that method to be recommended.

Fig. 19.—The velopharyngeal area of the palate shown in Fig. 17, without the prosthesis.



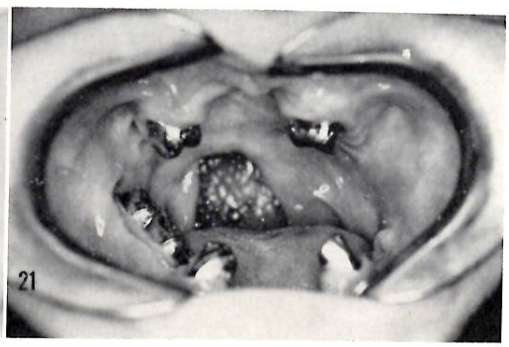


Fig. 20.—This patient had nine palatal operations which resulted in a low vaulted, contracted, scarred, and short palate. Note the crowns to protect the remaining teeth.

Fig. 21.—Five surgical procedures had been attempted in this palate. The soft palate is short and has no mobility.

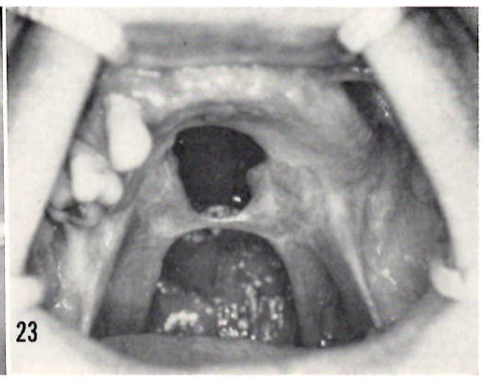


Fig. 22.—A palate after seven palatal operations. Two fistuals remain, the soft palate is short, scarred, and has no mobility. The nasal pharynx is rather large.

Fig. 23.—A large perforation of the palate exists after three surgical procedures. A prosthesis is indicated.

2. *Mental Retardation.*—A mentally retarded patient is not a good candidate for a prosthesis. An appliance needs reasonable personal care, and a mentally retarded individual may not be capable of such care.

3. *Uncooperative Patient and Parents.*—A prosthesis would not be given proper care in such a situation, and it should not be suggested.

4. *Uncontrolled Dental Caries.*—If caries is rampant and not controlled, a prosthesis of any kind should not be recommended. The edentulous condition itself is not a contraindication for a speech-aid prosthesis (Figs. 24-27).

5. *Lack of a Trained Prosthodontist.*—The construction of a functional prosthesis demands an understanding of the problem without which a satisfactory appliance cannot be built. Therefore, it would be better to resort to surgical ingenuity where experienced prosthodontic help is unavailable (Figs. 28 and 29). The prosthodontist engaged in cleft palate habilitation (1) should be thoroughly familiar with the anatomy and the physiology of the regions involved and with the basic rules governing fixed and removable partial denture prosthesis, and also (2) he should have received adequate training in cleft palate prosthodontics.

MAIN OBJECTIVES IN PROSTHETIC SPEECH APPLIANCE CONSTRUCTIONS

1. Each part of the prosthesis must be designed to suit the individual patient and situation in relation to his oral and facial balance, masticatory function, and speech.

2. All technique and disciplines in removable partial and complete dentures should be kept in mind in designing the maxillary part of the prosthesis. The preservation of the remaining dentition and surrounding soft and hard tissue in cleft palate patients is one of the main objectives. So often, the proper design of the maxillary part of the prosthesis is neglected. This results in the premature loss of the hard and soft tissue and further complicates the prosthetic habilitation (Figs. 30-33).

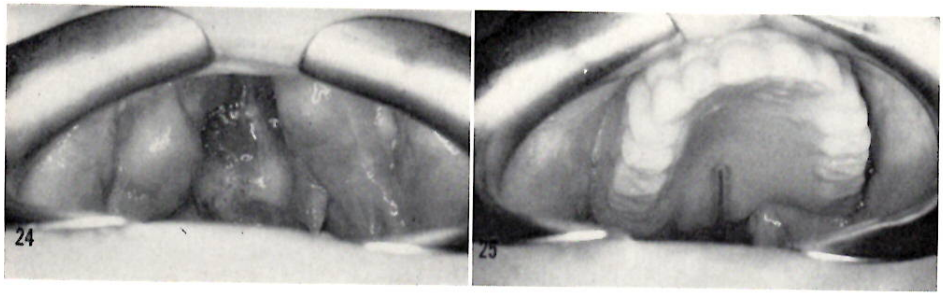


Fig. 24.—Edentulous cleft palate patients can be treated very satisfactorily with prostheses.
Fig. 25.—The prosthesis for the palate shown in Fig. 24 is in position.

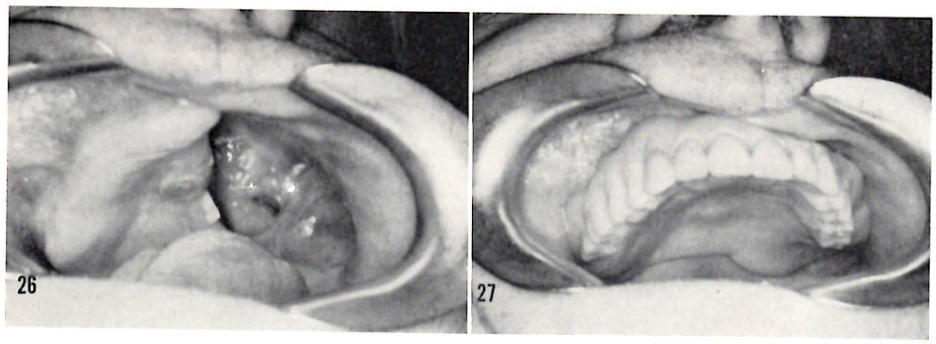


Fig. 26.—An edentulous patient with an acquired cleft of the palate due to hemimaxillectomy for the malignant lesion of the antrum.
Fig. 27.—The patient's speech, ability to eat and drink, social and family life is much improved with the insertion of the prosthesis (Fig. 26).

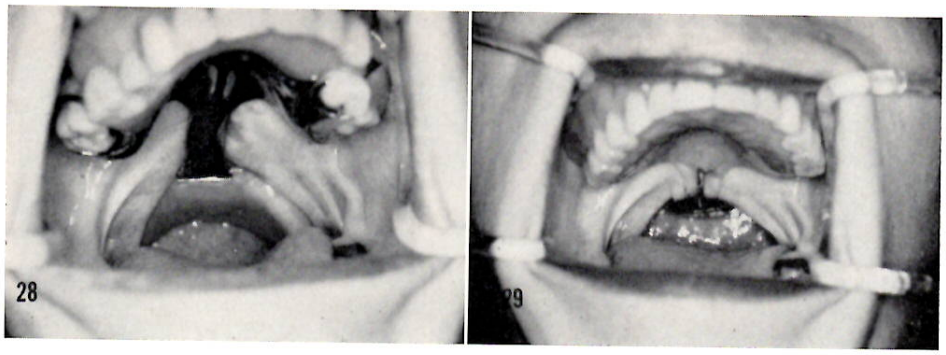
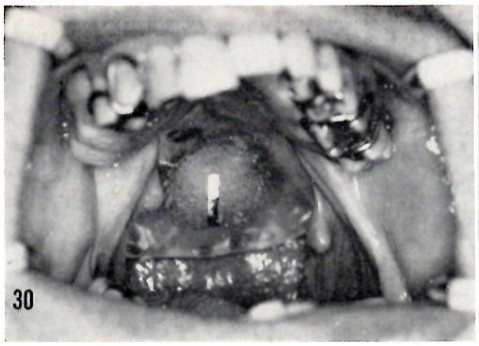


Fig. 28.—A nonfunctional and malpositioned pharyngeal section of the prosthesis. The prosthesis was easily displaced during swallowing and speaking due to muscle pressure on the pharyngeal section. This unstable prosthetic speech aid caused the two remaining teeth to develop Class III mobility within 6 months.
Fig. 29.—The two remaining teeth (Fig. 28) were removed and a complete denture speech aid was constructed. Note the position of the pharyngeal section in relation to the velopharyngeal musculature.



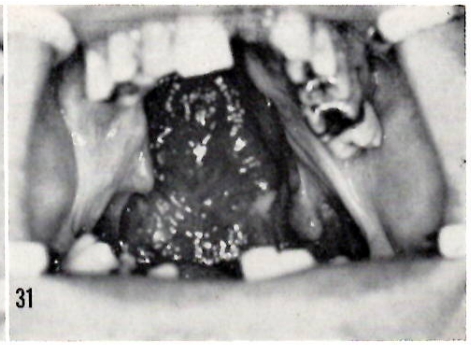


Fig. 30.—Improper treatment of the abutments and poor design of the anterior part of the prosthetic speech appliance have caused the remaining maxillary teeth to develop severe periodontal disease.

Fig. 31.—The palate (Fig. 30) without the prosthesis.

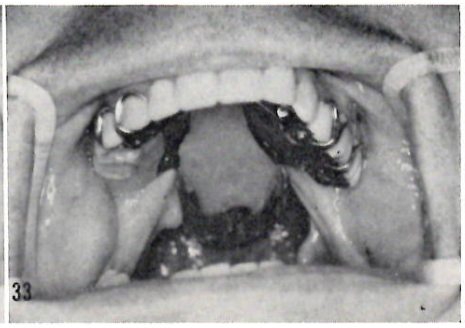


Fig. 32.—The remaining teeth were crowned and splinted together after periodontal treatment.

Fig. 33.—The new prosthesis for the palate shown in Fig. 32 has adequate support and retention.

3. The prosthetic speech appliance requires more retention and support than other restorations. In adult patients the crowning and splinting of the abutment teeth increase the retention and support of the prosthesis, and the life expectancy of the abutment teeth.

4. Full consideration should be given to the prosthetic treatment of the reduced vertical dimension of occlusion in the cleft palate patient. Lack of lateral and vertical growth of the maxillae and partial eruption of the deciduous and permanent teeth are often seen in patients with congenital cleft palate. Prostheses supported by natural teeth are the ideal treatment for this situation. Gingivectomy is performed to expose enough of the clinical crowns to make them usable. Copings are made for the remaining teeth to prevent decalcification and caries. These teeth are used only for support of the prosthesis and not for retention (Figs. 34-39).[5]

5. The weight of the prosthetic speech appliance should be kept to a minimum. The materials used should lend themselves easily to repair, extension, and reduction.

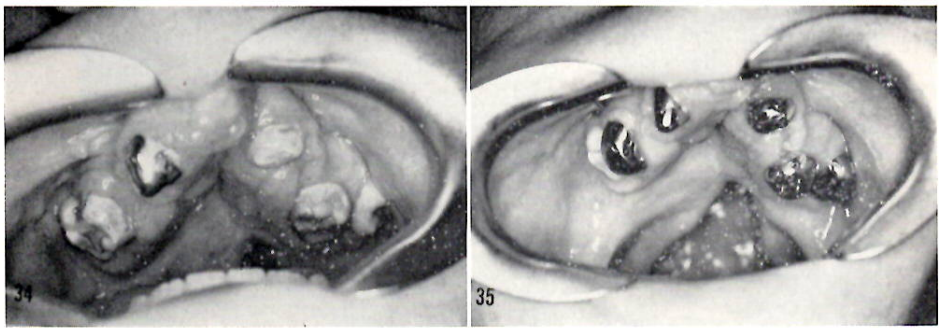


Fig. 34.—Partially erupted teeth, missing teeth, and an abnormal vertical and lateral growth and development of the maxillae are often seen in cleft palate patients. This 20-year-old postoperative patient with cleft lip and palate had these conditions which gave him the profile of a patient without any teeth. The soft palate was short, scarred, and had very little mobility. His chewing ability was poor. No occlusal contact was possible between the maxillary and mandibular teeth. After gingivectomies and crowning of the remaining teeth, a complete denture prosthetic speech aid, supported by the natural teeth, was constructed for the patient.

Fig. 35.—Gold copings are cemented over the remaining teeth shown in Fig. 34.

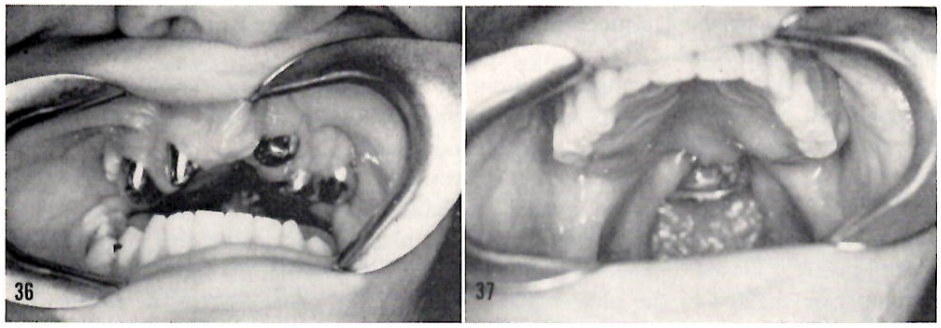


Fig. 36.—The maxillary and mandibular teeth do not contact when the patient's mouth is closed in centric occlusion. The patient has 15 mm. of interocclusal distance.

Fig. 37.—The prosthetic speech aid is in position for the patient shown in Fig. 34.

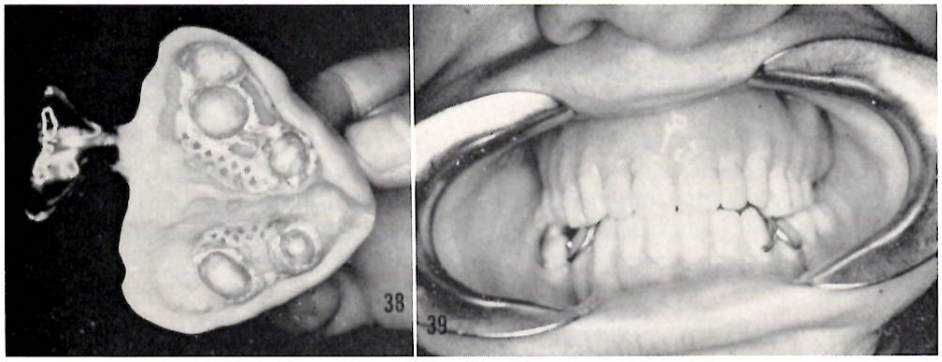


Fig. 38.—The cast gold thimbles are held in the resin base of the prosthesis by the lateral extensions on the castings.

Fig. 39.—The teeth are in centric occlusion with the prosthesis (Fig. 38) in position.

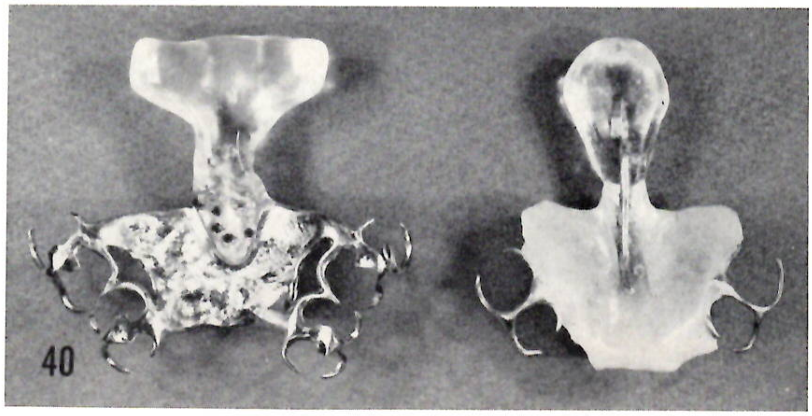


Fig. 40—*Right,* A temporary acrylic resin speech appliance with wrought wire clasps and full palatal coverage for a child, 4 years of age. *Left,* A permanent cast gold speech appliance with partial palatal coverage for an adult who had no missing teeth.

6. Soft tissue displacement in velar and nasopharyngeal areas by the prosthesis should be avoided.

7. The velar and pharyngeal sections of the prosthesis should not at any time be displaced by lateral and posterior pharyngeal wall muscle activities or tongue movement during swallowing and speech production.

8. The pharyngeal section of the prosthesis should be properly placed.[6,7] Cineradiographic studies of the normal soft palate reveal that, in about 90 per cent of the patients, velopharyngeal closure takes place in or above the level of the palatal plane.[7,8] Based on the study of the normal individual, we have been placing the superior surface of the pharyngeal section of the prosthesis on or above the palatal plane. However, we realize that the anatomic and physiologic differences in some patients might require the use of another position. In patients where the palatal plane was used as the point of reference, our speech results were encouraging. In the past, we have used the anterior tubercle of the atlas bone as a reference point. However, our investigation revealed that the relative position of the tubercle of the atlas bone varies in different individuals, and that the position of the velopharyngeal structures change in relation to it as the individual moves his head. Therefore, we no longer use the atlas bone as the reference point for positioning of the pharyngeal section.[6,8]

9. In the patient with post-pharyngeal wall activity, the pharyngeal section is positioned above the constricted muscle area. This location of the pharyngeal section eliminates undue muscle pressure against the pharyngeal section during speech and swallowing.[9]

TECHNIQUE OF CONSTRUCTING PROSTHETIC SPEECH-AID APPLIANCES

All three sections of the prosthetic speech-aid appliance for patients with deciduous, mixed, or not fully erupted permanent dentitions are made of acrylic resin. Wrought wire retainers without occlusal rest are used. In patients in whom

the permanent teeth are fully erupted, the anterior section of the prosthetic speech appliance should be made of cast metal or a combination of cast metal and acrylic resin (Fig. 40).

PRELIMINARY IMPRESSIONS

A stock tray of adequate dimension is selected. The fast setting irreversible hydrocolloid is used for this procedure. The following suggestions should be kept in mind when the preliminary impression is made:

1. The child should be given a chance to see and examine the tray; in some cases even let him try the tray in the mouth. He should be told that his cooperation would eliminate frequent repetition. His mind should be kept occupied by talking to him.
2. An uncooperative child should be sedated.
3. The patient should have an early morning appointment and an empty stomach.
4. A topical anesthetic should be used on children who have a severe gagging reflex.
5. The tray at no time should be over-packed. This would force the material into the nasopharynx and increase the difficulty of removal without fracture.
6. All perforations should be packed with gauze saturated with petroleum jelly.

PREPARATION OF THE DECIDUOUS TEETH FOR RETENTION

Most deciduous teeth do not have sufficient undercut for retention. However, a small amount of bilateral undercut can give adequate retention.

The following recommendations will help to produce adequate retention: (1) extend the clasp arms into interproximal areas of the teeth, (2) serrated platinum pins can be inserted into the buccal surface of deciduous molars to create an artificial undercut for the clasp, (3) bands with a soldered retention lug can be placed on the teeth, and (4) "Rocky Mountain Crowns" with a retention lug can be used for teeth with extensive carious lesions or areas of decalcification.

If sufficient space is not available for running the clasps between the teeth, space should be provided for them or the design should be changed. After the clasp design has been determined on the diagnostic casts and the teeth have been prepared for retention, the final impression is made.

FINAL IMPRESSION

An acrylic resin tray is constructed over the diagnostic cast. The patient is prepared the same as for the preliminary impression and the impression is made in an irreversible hydrocolloid impression material. Then the master cast is poured in stone.

RECORDING VERTICAL AND CENTRIC RELATIONS

All the usual steps for recording the vertical dimension of occlusion and centric relation are followed on patients who require complete or partial denture prosthesis.

THE DESIGN AND CONSTRUCTION OF THE PROSTHESIS

The master casts are surveyed and the prosthesis is designed by the prosthodontist, but consideration should be given to all of the problems involved. Where the orthodontist feels treatment is not indicated for a patient with a severely constricted maxillary arch and a mandibular arch of normal size, the teeth are set up outside the remaining natural teeth to establish the occlusion. Partially erupted teeth which are out of occlusion should be crowned and covered by acrylic resin to prevent food from being trapped around them.

The prosthetic speech appliance is constructed in three sections. The design of the anterior portion is similar to that of a partial or complete denture. The number of retainers is increased on partial dentures, if possible. After this section is completed, the patient wears it for at least 1 week. The length of this adjustment period depends on the ability of the patient to adapt to this part of the prosthesis. The construction of the middle part, the tailpiece or velar section, varies for operated and nonoperated clefts.

In nonoperated clefts with the 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 from the anterior extent of the uvula.

In operated palates which are short and 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.

CONSTRUCTION OF VELAR SECTION

A piece of shellac baseplate material of the required width and length is used to act as a tray. It is securely attached to the posterior part of the prosthesis with 2 mm. relief and is brought to the mouth for a check of proper extension. The upper part of the tray is filled with zinc oxide and eugenol impression paste and the appliance is inserted in the mouth. The patient is instructed to hold his head in a vertical position for 1 minute to prevent the escape of the impression material into the nasopharynx. After 1 minute, the patient is instructed to swallow some water so the muscular movement of the soft palate will be registered in the impression. After the material is set, the prosthesis is removed from the mouth and the tailpiece is processed. In order to reduce the number of times the appliance has to be heated, self-curing acrylic resin is used for making the tailpiece. The denture with the finished tailpiece attached is placed in the mouth for testing. The ejection of water from the mouth by the patient stimulates muscle action along the lateral edge of the velar section. If the velar section is overextended laterally, it will cause undue muscle displacement and eventual tissue soreness.

CONSTRUCTION OF PHARYNGEAL SECTION OR 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 to extend beyond the superior part of the tailpiece. 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 by 7 roentgenogram is made in the sagittal plane in order

to locate the position of the wire in relation to the palatal plane. Green modeling compound is added around the wire loop to reinforce the attachment of the wire to the tailpiece. The appliance is inserted into the mouth and the patient is asked to swallow some water. The wire should be adjusted so it does not contact the pharyngeal wall. Adaptol,* softened in water at 150 to 160° F. for 4 to 5 minutes, is added over the green compound and the wire loop is manipulated into an oval form and inserted into the mouth. Again the patient is instructed to swallow some water to produce muscle activity that will mold the impression material.

The prosthesis is reinserted a number of times, with more Adaptol being gradually added to the mass on the wire loop until a functional impression is made of the lateral and posterior pharyngeal walls. The impression material is molded by instructing the patient 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 further molding of the impression material by muscular activity. If the mass is over-extended, it will be felt by the patient during these actions and during speech.

To check the position of the bulb, tinfoil is adapted over the impression and another 5 by 7 sagittal roentgenogram is made. The tinfoil will show in the roentgenogram and reveal the position of the bulb in relation to the palatal plane. When the bulb form has been perfected, the bulb and tailpiece are processed on the denture in heat-curing acrylic resin.

For those patients whose tissues of the posterior and lateral pharyngeal walls are sensitive enough to produce 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 under-extended bulb, process it in self-curing acrylic resin, and let the patient become adjusted to it for 2 or 3 weeks. After the patient is accustomed to the undersized bulb, a final impression is made by adding Adaptol to the bulb. The final impression of the speech bulb is processed in heat-curing acrylic resin.

A length of 11-gauge half-round wire is incorporated in the appliance and the bulb; it should extend from the anterior part of the appliance to prevent swallowing of the bulb in case the tailpiece is fractured.

INSERTION OF THE APPLIANCE

The finished speech appliance is inserted in the mouth and checked for: (1) muscle adaptation to the speech bulb during swallowing and phonation, (2) excessive pressure against the posterior and lateral walls of the pharynx, (3) stability of the appliance during function, and (4) the improvement of the voice quality and the articulation of speech.

POSITION OF SPEECH BULB

Data pertaining to the supero-inferior dimension and position of the pharyngeal section upon voice quality and acoustics are being analyzed. In most patients, we found that when the bulb is positioned too far inferiorly, the pharyngeal section has the following undesirable effects: (1) it has a tendency to be displaced by

*J. F. Jelenko and Co., Inc., New York, N. Y.

the dorsal part of the tongue during tongue movements, (2) it fails to relate to the normal region for making adequate velopharyngeal closure, and (3) it has a deterimental acoustical effect upon the quality of the voice.

SUMMARY

A mutual restraint and understanding within the professional team are necessary if the patient with oral-facial-speech difficulties is to gain full benefit of treatment. The repair of a cleft of the palate in most patients is a surgical challenge. However, there are some situations in which a prosthesis is the treatment of choice. Greater knowledge of the nature of the cleft palate defect through research and the use of better diagnostic tools has made possible better service for patients with a cleft palate.

A prosthodontist engaged in treating oral-facial-speech handicapped people should be thoroughly familiar with: (1) the anatomic and physiologic deviations of the region involved, and (2) the basic principles involved in prosthetic dentistry, and (3) he should be willing to acquire further knowledge in this field.

REFERENCES

1. Cooper, H. K.: Cinefluorography With Image Intensification as an Aid in Treatment Planning for Some Cleft Lip and/or Cleft Palate Cases, Am. J. Orthodont. **42**:815-826, 1956.
2. Cooper, H. K.: Recent Trends in the Management of the Individual With Oral-Facial and Speech Handicaps, Am. J. Orthodont. **49**:683-700, 1963.
3. Mazaheri, M.: Indications and Contraindications for Prosthetic Speech Appliances in Cleft Palate, Plast. & Reconstruct. Surg. **30**:663-669, 1962.
4. Pruzansky, S.: Factors Determining Arch Form in Clefts of the Lip and Palate, Am. J. Orthodont. **41**:827-851, 1955; correction, p. 941.
5. Mazaheri, M.: Prosthetic Treatment of Closed Vertical Dimension in the Cleft Palate Patient, J. Pros. Den. **11**:187-191, 1961.
6. Aram, A., and Subtelny, J. D.: Velopharyngeal Function and Cleft Palate Prosthesis, J. Pros. Den. **9**:149-158, 1959.
7. Mazaheri, M., and Hofmann, F. A.: Cineradiography in Prosthetic Speech Appliance Construction, J. Pros. Den. **12**:571-575, 1962.
8. Mazaheri, M., Millard, R. T., Erickson, D. M.: Cineradiographic Comparison of Normal to Non-Cleft Subjects With Velopharyngeal Inadequacy, Cleft Palate J. **1**:199-209, 1964.
9. Cooper, H. K., Long, R. E., Cooper, J. A., Mazaheri, M., and Millard, R. T.: Psychological, Orthodontic, and Prosthetic Approaches in Rehabilitation of the Cleft Palate Patient, D. Clin. North America, pp. 381-393, 1960.
10. Pruzansky, S., and Lis, E. F.: Cephalometric Roentgenography of Infants: Sedation, Instrumentation and Research, Am. J. Orthodont. **44**:159-186, 1958.

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