An Extraorally Activated Expansion Appliance for Cleft Palate Infants

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A new lever-action expansion appliance is described which is designed specifically for use in infants with cleft lip and palate. An extraoral control knob allows for easy activation, while the important anterior cleft areas are left clear for premaxillary repositioning and clinical assessment. Activation is registered by a positive clicking sound. Rapid expansion is made possible by the design of the appliance which is retained by stainless steel pins.

Introduction

Removable intraoral appliances, although easily activated, have not been a reliable means for expanding the palatal segments in cleft palate infants. This is mainly because of difficulty with retention. Not only is there a need for positive retention but also for a continuously adjustable appliance which obviates the need to make a series of passive acrylic plates. This latter problem was solved by the incorporation of standard orthodontic expansion screws and wire springs. However, the effectiveness of such screws and springs relates to and depends upon retention. A number of methods have been used to improve the retention of intraoral appliances in infants, including the use of denture adhesive, the extension of the appliance into nasal cavity undercuts with elastic materials (Georgiade, 1964), and tapes tied around the neck.

The introduction of the pin-retained appliance has opened the way for more positive technology in the treatment of cleft lip and palate infants. In this paper we describe a new appliance designed to provide for extraoral activation over a wide range of expansion travel for dealing with collapsed maxillary segments in infants.

The appliance

RETENTION BY INTRA-BONY PINNING. Hagerty (1957) has described an expansion mechanism consisting solely of an expandable bar of stainless steel, the pointed ends of which were inserted into the palatal bone for secure

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retention. Intra-bony fixation as the principle for retention was later incorporated into an acrylic-based appliance using standard expansion screws (Hagerty, et al, 1965). Georgiade (1970) designed and used with success a "staple" pin made from stainless steel wire for retention of clear acrylic plates. The use of this method is currently increasing.

While the fixation of an acrylic appliance to the palatal segments by means of stainless steel pins solves the retention problem, it limits the activation of the appliance. The activation of a conventional expansion screw in a pinned appliance is a difficult matter in an infant who must be restrained. There is also a danger of dislodging the appliance. In attempts to achieve continuous activation, the pinned appliance has been used in conjunction with a coil spring. This approach has, in our experience, been unsatisfactory for rapid expansion of the maxillary segments.

Appliance Design. The basic appliance frame is made of stainless steel and is mounted in an acrylic polymer base adapted to a dental model (Figure 1). The expansion mechanism is of a lever action design using an anteroposteriorly mounted screw on which is threaded a T-shaped drive piece. The drive piece and screw are housed in a drive box that extends posteriorly from a transverse pivot bar which spans the maxillary tuberosities (Figure 2). The centers of rotation for the maxillary segment arms are located at the ends of the transverse pivot bar. This center of expansive motion is located over the maxillary tuberosities. Thus the expansion of the maxillary segments obtained anteriorly should not be accompanied by a decrease in the intertuberosity width. The central drive screw is connected through a universal joint to a wire handle which extends extraorally to facilitate activation.

The posterior location of the drive box and screw provides an unobstructed view of the anterior palatal area so that clinical progress may be readily assessed. In the case of retraction of a protruded premaxillary segment, a free pathway is provided to accommodate the repositioned premaxillary segment. From its completely contracted position, when the distance between the ends of the maxillary segment arms measures 20.0 mm., the appliance has a total arch expansion range of 15.0 mm. One revolution of the activation screw provides approximately 1 mm. of expansion between the anterior ends of the maxillary segments.

The activation screw carries a facetted collar between the screw head and the threaded shaft. This collar inserts into the drive box between opposing metal surfaces which hold the collar in a close fit. Rotation of the activation screw produces a clicking sound at each quarter turn as the collar pushes the drive box members slightly apart, and these then spring back into place (Figure 2). This provides positive evidence of activation in response to turning the extra-oral handle and prevents the tendency of the screw to back off in a reverse direction, which would deactivate the appliance.

Stainless Steel Staples. The expansion staples are bent from 0.030 inch (0.76 mm.) stainless steel wire of spring temper, 8 mm. wide (outside measurement) and 12 mm. in length. The site and direction of insertion of the stainless steel pins can be precisely determined prior to mounting the appliance

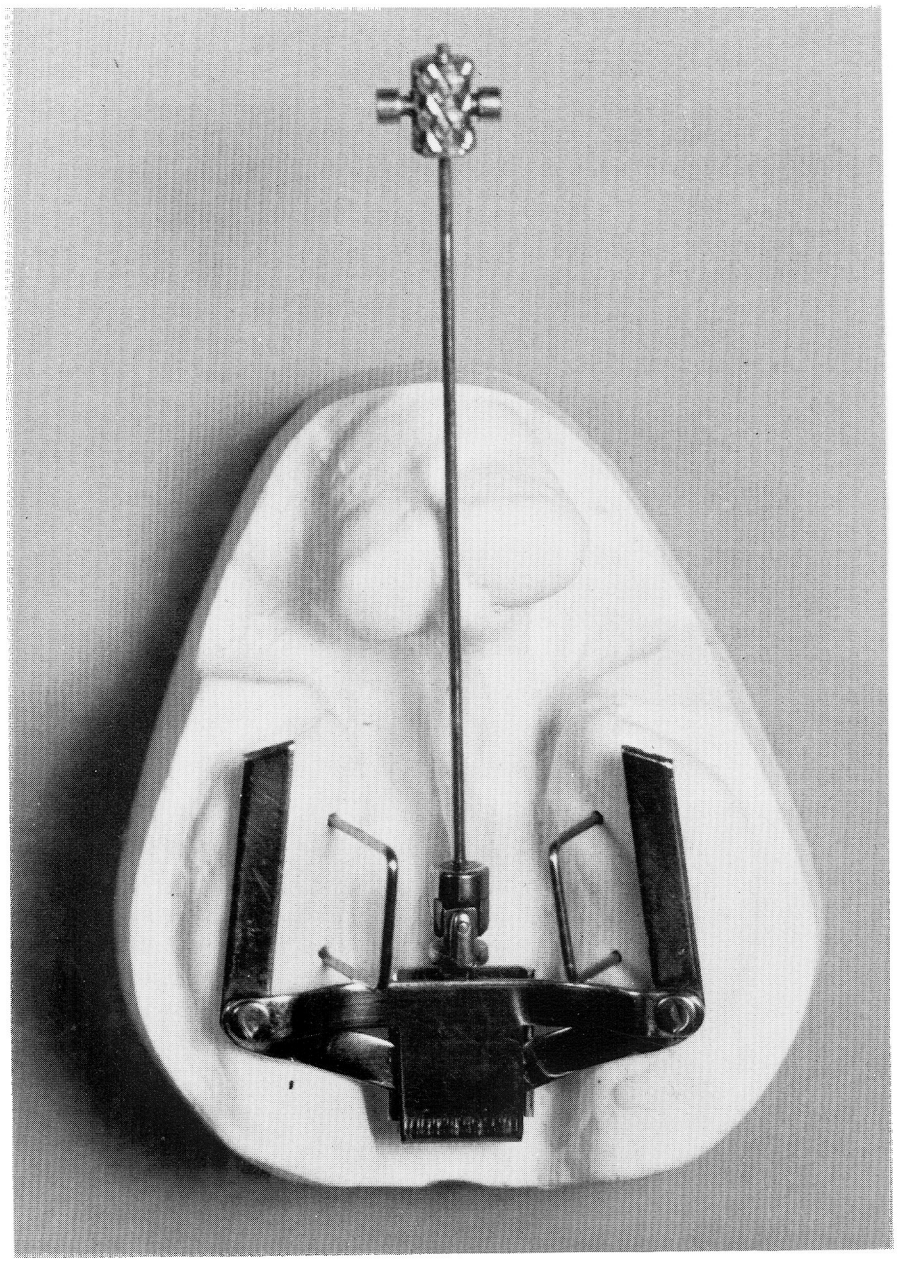

FIGURE 1. The extraorally activated appliance frame placed on model of bilateral cleft infant, stainless steel staples used for retention are inserted into holes in model to hold them in correct orientation. Wire handle with universal joint for flexibility extends from drive box to beyond lips for easy control.

in acrylic polymer on the dental model. We recommend that the dentist or surgeon determine these during the planning stage, indicate by marks on the

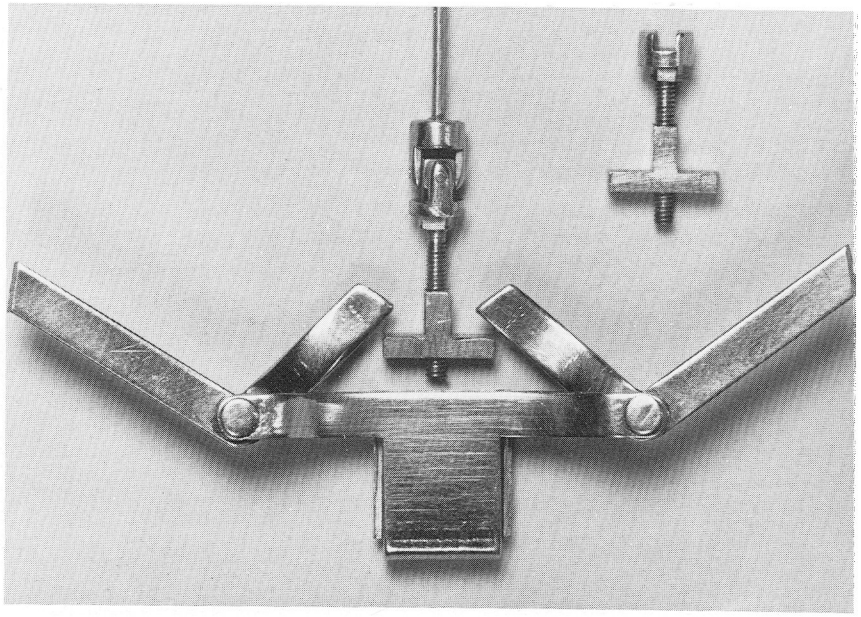

FIGURE 2. The appliance opened out to show drive mechanism. The thrust arms engage the "T" piece which is movable by turning control screw.

dental model where the dental technician will make the drill holes, and stress that the staples lie at an angle of no more than 15 degrees from the vertical in order to avoid tooth germs. Smooth gingival or gum pads overlie the developing teeth and are bounded on their medial aspect by a groove that corresponds to the medial plate of alveolar bone, the mucogingival groove. The point of entry of the pin should be located several millimeters medial to this groove where the palatal mucosa is supported by the horizontal processes of the maxillary and palatine bones. The pins must be directed to insert into the bone of the horizontal palatal processes, and the slight lateral inclination of the pins ensures good functional retention. Holes are drilled in the model plaster about 4 mm. deep to hold and orientate the pins, point outwards.

The pins are lubricated lightly with petroleum jelly and inserted into the prepared holes in the dental model. The expansion metal appliance is placed in position and the application of the acrylic polymer by the powder-and-drop method is then followed. The drive mechanism and moving parts, everything posterior to the anterior edge of the transverse pivot bar, are blocked out with plaster. This avoids obstruction of the moving parts by acrylic polymer. The staple pins are incorporated into the hardened acrylic polymer and are withdrawn for laboratory finishing and polishing.

The angles and positions of pin insertion are preserved. When the appliance is seated in the mouth, as on the model, the staples will take the predetermined direction into the palatal mucosa and bone.

Following insertion of the appliance into the mouth, the staples are driven into

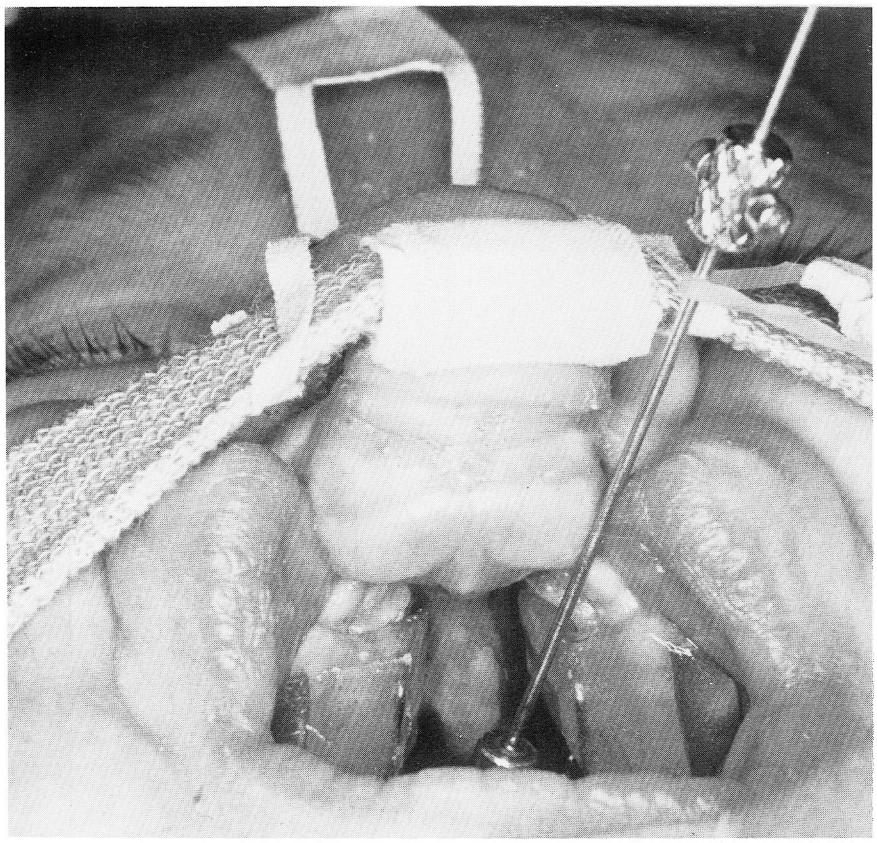

FIGURE 3. Photograph of 6 week old infant showing collapsed maxillary segments and appliance used for rapid expansion in association with retraction of premaxillary segment with a facial strap.

position using an automatic centre punch* on which the punch point has been grooved for engaging the staple top. The staples are then secured with a little cold-cure acrylic polymer. Self-locking staples are being tested and their success should greatly simplify the insertion.

Clinical Application

Control of the position of the maxillary segments constitutes one of the major problems in the treatment of the malformed cleft palate. This lever-action appliance provides rapid expansion of collapsed maxillary segments in a period of one week or less and may be used in conjunction with simultaneous retractive force applied to a protruded premaxillary segment (Figure 3).

When retraction of the bilateral cleft premaxillary segment is required prior to lip surgery, it is frequently necessary to expand collapsed maxillary segments that would be obstructive. Figure 3 illustrates such a case where the expansion

* General Hardware Mfg. Co., Inc., New York, N.Y. 10013

appliance was used to provide rapid expansion while a Burston type of facial elastic strap was employed for premaxillary retraction. Where a closed lip is utilized to provide premaxillary repositioning, the need for maxillary expansion is the same. The appliance would be inserted at the time of lip surgery, immediately activated about two millimeters, and activated again before leaving the hospital and at subsequent office visits. It may be kept in the mouth for up to four to six months.

In the case of hospitalized patients, routine daily activation of the expansion appliance is readily achieved by turning the handle protruding just beyond the lips (Figures 3 and 4). When used on an outpatient basis, the long handle is replaced by a short screw (13 mm.) which is turned by a screwdriver (Figure 2).

This expansion appliance was developed in conjunction with a mechanism for the rapid retraction of the protruded premaxillary segment in infants with bilateral cleft lip and palate (Georgiade and Latham, 1975). The latter appliance combines the functions of maxillary segment explansion and premaxillary segment retraction into one compact coaxial arch alignment appliance. However, the device described here is intended solely for expansion and stabili-

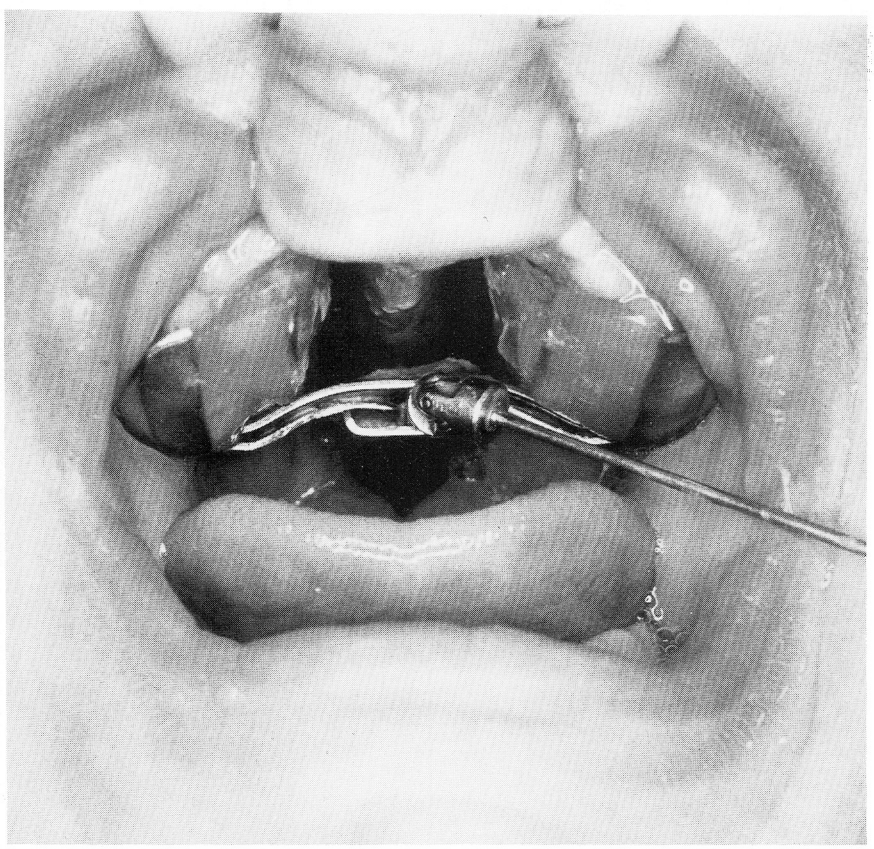

FIGURE 4. Intraoral view of same infant after 4 days, showing expansion of maxillary segments proceeding well. The drive box is located in posterior cleft area.

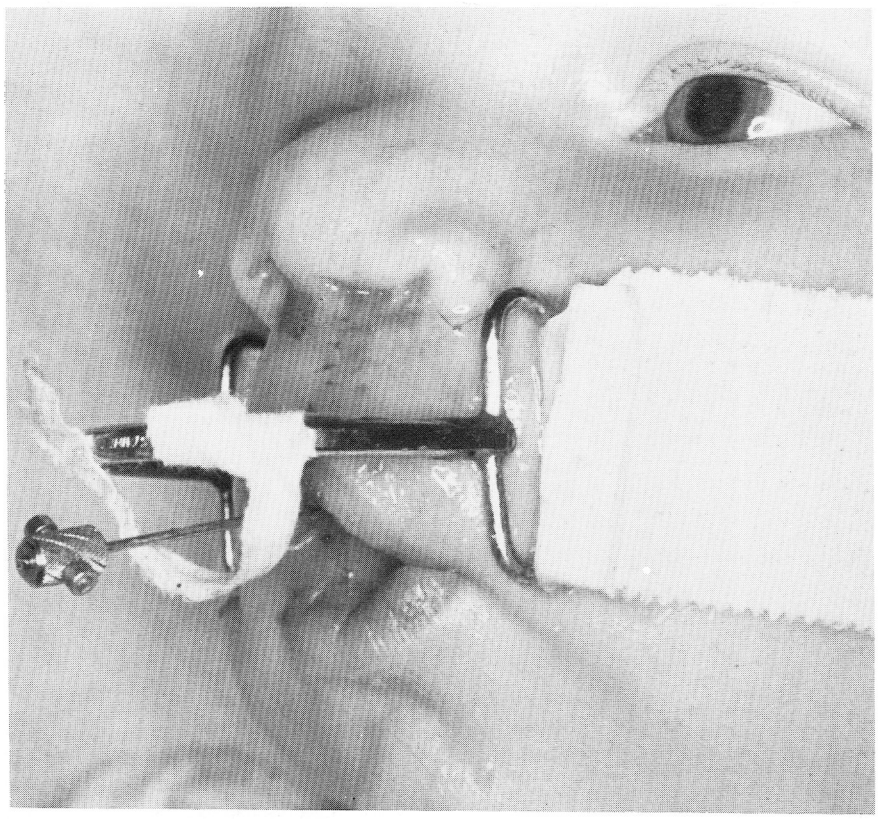

FIGURE 5. Infant after surgery for unilateral cleft lip with Logan's bow to relieve tension on repair. The control handle of expansion appliance extends forwards to an accessible position for activation in correction of collapsed maxillary segments.

zation purposes and is more closely adapted into the cleft area than the similar component of the coaxial arch alignment appliance. In the latter, the posteriorly located transverse pivot bar is placed horizontally between the maxillary tuberosities in order to provide an optimum level of anchorage from which to apply retractive force to the premaxillary segment.

The unilateral cleft infant may have an extremely collapsed maxillary segment at the time of lip surgery. Insertion of the appliance in the operating room before proceeding to close the lip provides a controlled means for expansion as soon as healing of the lip permits (Figure 5). Thus the prominent premaxillary dento-alveolar ridge may respond to the forces applied by the lip and mold into an abutment relationship to the expanded cleft maxillary segment.

Advantages

The combination of ease of activation with direct intra-osseous pinning makes rapid expansion possible. Such capability is desirable in the care of patients who, having travelled a long distance, are hospitalized for a period of rapid

orthopaedics prior to surgery. Alternatively, on an outpatient basis, parents who have been instructed may easily cooperate in the activation of the appliance to obtain the desired expansion.

An important advantage is the control of the amount of expansion to be achieved. The range of activation has proved adequate in our experience.

Disadvantages

The pinned appliance is regarded by us as suitable for short-term purposes covering a period up to six months. Such purposes usually relate to and are planned with regard to surgical procedures. A main limiting factor is the tolerance of the pins by the tissues in which they are embedded. We have always been impressed by the health of the mucosa adjacent to the pin sites and the absence of ulceration.

In its present form, the insertion of the appliance is carried out in the operating room under general anaesthesia employing an endotracheal tube. The main reasons for this are the requirements for the use of the rapid cold-cure acrylic polymer with which the staples are cemented in place for secure attachment to the acrylic bases. This is best performed with the patient still with the mouth open and the lower jaw relaxed. We do not recommend the use of sedation only because the infants tend to clench their jaws in an obstructive manner.

The use of the appliance requires the availability of dental technical facilities for mounting the standard metal frame in acrylic polymer. Efforts are continuing with the hope of reducing technical requirements to a minimum. If a self-retaining staple can be developed, insertion could become an office procedure.

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