Invisible retainers

Robert J. Ponitz, B.S., D.D.S., M.S.
Ann Arbor, Mich.

Methods of retention in orthodontic treatment seem to have undergone more drastic change than have many other aspects of practice. For this reason, the changes in retentive appliances will be reviewed briefly and experience with the invisible retainer will be presented.

History

Retainers used around 1914 by Hawley and others[10] were basically fabricated from gold wire and vulcanite. Since about 1937, steel wire and acrylic retainers have been used extensively. Many variations of the original design of the wire have been made through the years. The circumferential wire first was used by Paul Ponitz[18] in 1946. Combinations of body wire, auxiliary wires, and elastics also have been used. Autopolymerizing methyl methacrylate was first used clinically by me in 1952. Cobalt wires first became available around 1955.[7] Conventional premolar and second molar clasps and also ball-and-arrowhead clasps have been used.

On July 21, 1923, Remensnyder[1] introduced a rubber[2] Flex-O-Tite "gum-massaging appliance" which was first patented on Nov. 13, 1928. He described minor movements of teeth achieved with his first patented appliance.[3] Remensnyder's second patent[6] used the term "orthodontic appliance"—a one-piece rubber device.[4]

Vulcanite positioning retainers were popularized by Kesling,[5] Rocke, and others after 1943. Plastic finishing appliances have been used by others and myself for the past 10 years, but black vulcanite rubber is still preferred by many clinicians[8] because of its special physical properties.

Godwin,[11] Torbet, and others have pioneered in the fabrication, at modest cost, of large numbers of mouth guards for athletes.[9] Shanks first showed mouth guards, transparent retainers, and a machine capable of producing them in 1963. Cellulose acetate butyrate, polyurethane, polyvinylacetate-polyethylene polymer, polycarbonate-cycolac, and latex are the materials most frequently used in these applications. Special vacuum units that can be used to make plastic finishing appliances have been developed. Heating element capacity

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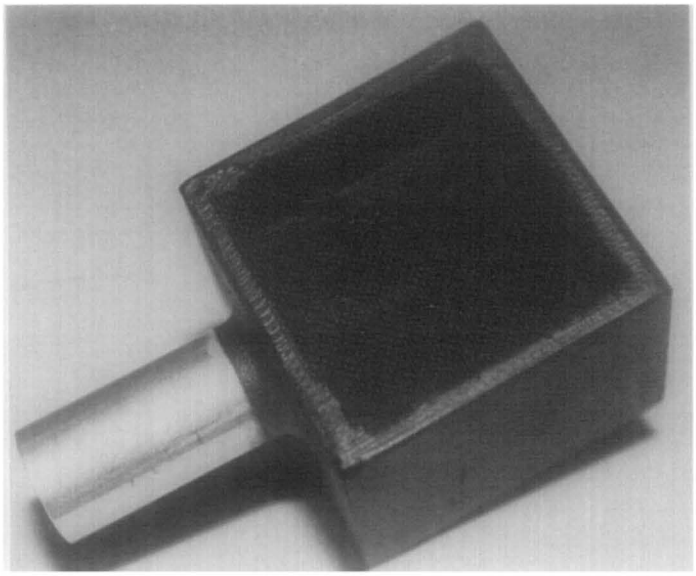

Fig. 1. Vacuum box with grid and tube.

has been found to be insufficient for the present application in some commercially available vacuum units.

Fabrication of appliance

The vacuum unit (Fig. 1) consists of a box, grid, and tube. A tank type of vacuum cleaner is used to provide the suction required. A frame (Fig. 2) is used to hold a plastic blank securely in place during heating over an electrical source of heat. A surface unit of 220 volts is more convenient, but two 110 volt units can be used satisfactorily. The second element is placed, heating downward, about 9 inches above the first element, which is placed heating upward (Fig. 2). The temperature should be from 340 to 420° F., although the preferred range of temperature is 370 to 390° F.

An impression of either arch is made by the method of one's choice. A model, without a base, is poured with improved stone or die stone. The model is placed with the anterior teeth toward the source of vacuum (Fig. 3). If protective packaging sheets are present, they are removed from the square of plastic to be used. The clear plastic, 5 inches square, is preheated in an oven for 15 minutes at 250° F. A sheet of preheated clear plastic is placed in the frame and heated over the electrical burner. The frame is kept moving in a horizontal pattern to avoid overheated spots which cause bubbles in the finished appliance. When the plastic slumps or begins to smoke, the vacuum device is turned on and the frame of heated plastic is placed immediately over the model on the vacuum unit (Fig. 3). An asbestos-gloved hand or a hot pad can be used to provide pressure in adapting plastic closely to the model. The speed of the motor will increase as the grid on the unit is sealed. A foot switch frees both hands for use in forming the appliance.

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Fig. 2

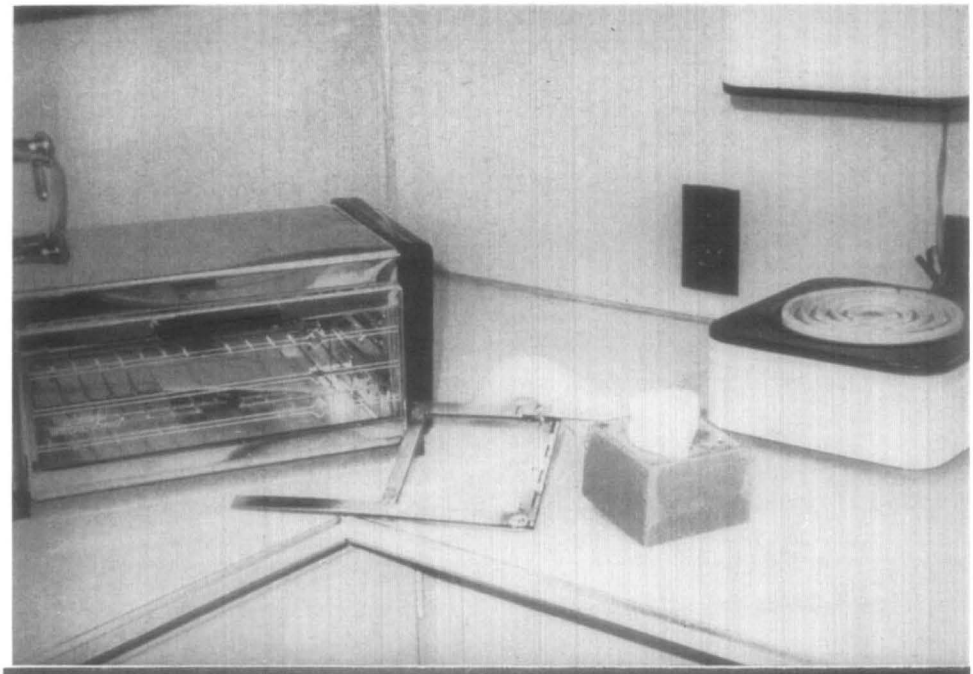

Fig. 3

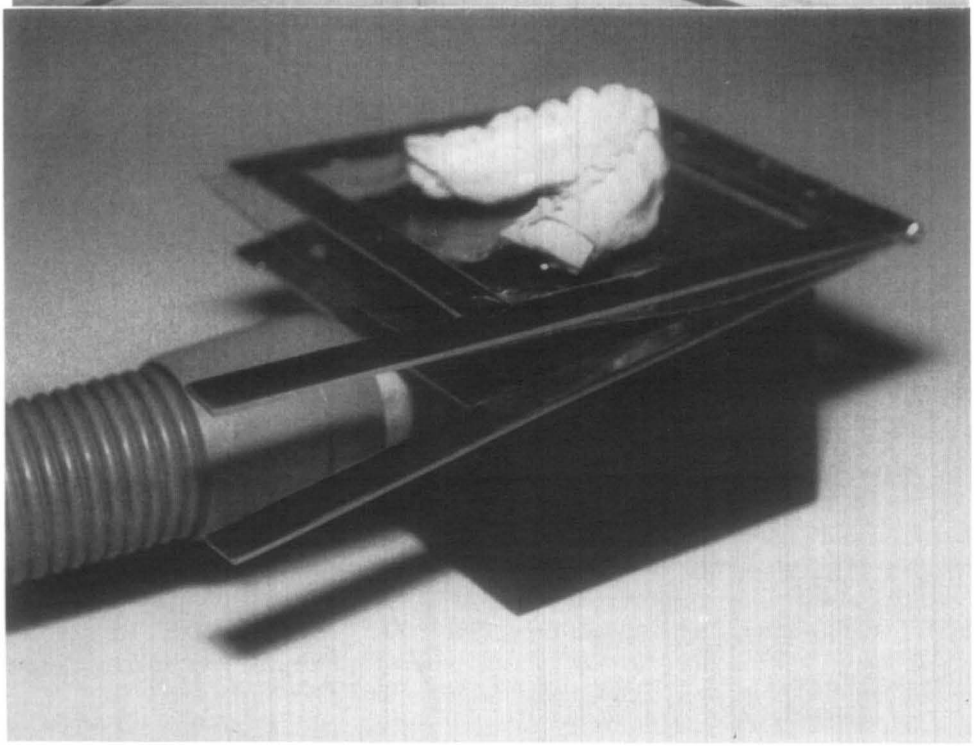

Fig. 2. Preheating oven at left. Twin 110 volt heating elements at right.

Fig. 3. Invisible retainer formed.

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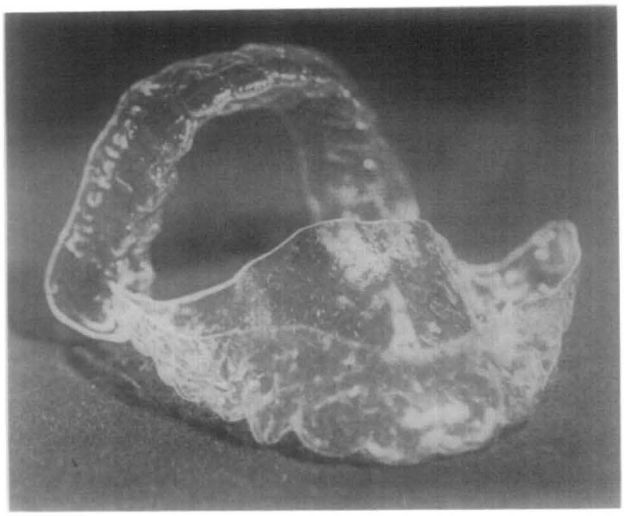

Fig. 4. Invisible retainers ready for use.

The flash is trimmed away with coarse tin snips. A Vulcarbo, Joe Dandy, or knife-edge disk in a mandrel is used to carve the approximate periphery of the retainer. At this point, the retainer is lifted off the model with the large end of an inverted No. 7 wax spatula and trimmed with curved, nonserrated crown-and-bridge scissors. Finally, the edges are polished with an Indianhead pear-shaped stone. The patient's name can be carved in the flange with a small half-round bur or a vibrating stylus instrument of the type usually used to mark metal objects.

Teeth can be moved and repositioned in pink baseplate wax on the master model before the appliance is formed. The patient's teeth then can be moved to reasonable new positions by means of the retainer (Fig. 5). Bite planes can be formed on the model with asbestos material, and retainers can be formed over the asbestos with or without acrylic between the retainer and the patient's tissue. Acrylic bite planes can be formed over or under the clear plastic and bounded to the plastic with self-curing acrylic liquid. Denture teeth can be attached in edentulous areas in the same way. Plastic denture teeth usually are chosen for convenience. They bond to the appliance if covered with a drop of self-curing liquid just before the appliance is formed. Vinyl[17] is customarily used to form mouth guards and appliances for the correction of bruxism. This type of material is readily available from supply houses and can be used to gain greater changes in the position of teeth than the harder and clearer invisible material for the retainer will permit.

Final finishing, positioning appliances can also be made from vinyl blanks or wafers. Some blanks are heated in boiling water, while others are softened with dry heat. The heated wafer then is placed over the model, and a squared coffee can with a petrolatum-lubricated rubber dam banded to place is quickly placed over the plastic to form it on the vacuum unit.

When both surfaces of the clear plastic sheet are smooth, either side may be

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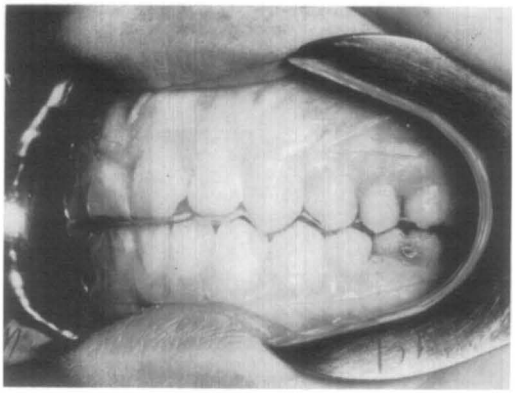

Fig. 5. Invisible retainers being worn.

placed up or down in forming the appliance. If one surface is a matte or has a dull finish, the matte should be placed toward the model when the invisible retainer is formed. Should the plastic sheets be packaged with a protective polyethylene thin-film wrapping or interlining, the protective sheets should be removed before preheating, as mentioned previously.

Additional implications

At the present time, invisible retainers usually last many months to a few years. The standard appliances made of wire and acrylic or of rubber usually last many years. As materials improve, comparable life expectancies may be anticipated in the future. Today's challenges for plastics seem to result in tomorrow's accomplishments.

Invisible retainers fit as accurately as the impression and model permit. Usually, no adjustment is needed. Occasionally, the periphery will require reduction for the attachments of muscles. Heat guns can be used to join cracks, separations, or split areas in the plastic. Usually it is preferable to make a new appliance after considerable wear has occurred. The ease of fabrication, the speed of insertion, and the almost complete lack of need for adjustment have amazed all who have used these appliances. It is usually easier to remake than to repair an invisible retainer.

Periodontists[12] have found invisible retainers valuable for keeping surgical packs in place with maximum comfort for the patient. These appliances have been used successfully as splints to stabilize traumatic and surgical fractures of the maxilla, premaxilla, and mandible until the bony fragments heal. Temporary partial dentures[15] have been made and used with excellent acceptance. These appliances also have been used as splints for the treatment of bruxism,[19] traumatized teeth, and the correction of oral habits. A maxillary and a mandibular retainer can be fused to make a surgical splint or a finishing appliance.

Webbing or folding of the appliance upon itself is a common problem encountered in the use of thermoformed materials. Usually this fault comes from excessive temperature when the appliance is being formed. Leaving an extended base on the model, insufficient vacuum or pressure, delay between heating and

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