

Fabrication and Insertion of Removable Appliances

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Introduction

Removable orthodontic appliances hold a unique place in the orthodontist's armamentarium. Traditionally, removable appliances fall into three main categories:

1. *Retainers*
2. *Functional appliances*
3. *Simple, specific limited tooth movement*

More recently, removable computer generated acrylic aligners have been introduced as a means to comprehensively treat the complex malocclusion. Removable appliances have two distinct advantages. They can be removed for socially sensitive situations and they are fabricated in the dental laboratory, reducing dentist's chair time. Removable appliances also have significant disadvantages. Success is closely linked to patient compliance. It is technically difficult to obtain the two point tooth contact to achieve complex tooth movements, limiting the scope of treatment possibilities.

The following article will outline the historical development of the simple removable appliance its fabrication and the role of the simple removable appliance in today's general dental practice.

Background

The simple removable appliance is made up of three major components including the retentive component (clasps), a framework or baseplate and a tooth moving element (spring or screw). While advances in material science have furthered the development of the simple removable appliance, the inherent weakness of the appliance is in the retentive component.

In other words, the active component is only as effective as the retentive element holding the appliance in place. If the active component is too strong or too complex in its method of force delivery, the appliance will dislodge and will fail in its intended objective.

In the early 20th Century, the American Victor Hugo Jackson was a supporter of the use of bulky removable appliances made of vulcanite and precious metal wires. In the early part of the 1900's the precious metal Crozat appliance came into vogue in the Southern United States but had a minor impact on orthodontics throughout the remainder of the United States. In general, the US focused on fixed appliances while removable appliances flourished in the European market. Some of the European influence penetrated the US market. Marvin Schwartz of Vienna popularized the split plate design and Philip Adams of Belfast developed the Adams clasp.

The simple removable appliance is useful in simple, limited tooth movements. The two main types of tooth movements possible with simple removable appliances are arch expansion, both in the anterior incisor expansion and transverse arch expansion in the buccal segment.

Anterior Expansion of Maxillary Incisors

One of the most common uses of the simple removable appliance is the resolution of the single anterior cross-bite, when space exists for the accommodation of the tooth in question. This appliance, in particular, requires occlusal coverage of the posterior teeth to separate the anterior teeth and allow for 'unlocking' of the anterior crossbite. The appliance also incorporates retentive clasps and a flexible spring lingual to the incisor in cross-bite.

Transverse Expansion of the Arches

A removable appliance of split-plate design will expand the arch by tipping the posterior teeth buccally via one point contact. Unlike a rapid palatal expander, expansion is purely dental in origin; no sutural expansion occurs. Removable split plate expanders are limited in their indication. They are contraindicated in cases of skeletal constriction and posterior crossbites of more than 5 mm. Excellent retention of the appliance into the undercuts of the maxillary posterior teeth is a prerequisite to predictable results. The screw is customarily placed in the midline of the appliance and produces high force levels that dissipate rapidly. The screw is activated one turn 0.25 mm per week for a total of 1 mm per month.

Appliance Components

1. *Clasps*

The Adams clasp is the most widely used clasp used in removable appliances. It is made of .028 inch stainless steel wire. The retentive points of the clasp must fit well into the undercuts of the teeth for ideal retention. The more active the appliance, and the greater the force applied during its use, the more clasping required to keep it in place. Additional retention may be gained by soldering additional retentive elements to the clasp. Other, less popular clasp designs include the circumferential, ball and lingual extension clasps.

2. *Framework*

The framework, or baseplate, component of the simple removable appliance can be made of a variety of contemporary plastic materials. The framework must fit ideally for the appliance to be successful. In general, maxillary appliances are better stabilized than mandibular appliances. In addition, mandibular appliances tend to have greater lingual undercuts, making ideal posterior fit of these appliances less predictable

3. *Active Elements*

The most common active element in the simple removable appliance is the stainless steel spring. Springs must have adequate springiness and range while remaining strong enough to resist deformation. In addition, the spring must be guided so its activation is concentrated on the appropriate tooth. The ideal spring is larger than .020" wire. An increase in the wire diameter provides the strength to prevent destruction while in the mouth. Range and springiness are built in by increasing the length of wire incorporated into the spring. However, the longer the spring, the greater the difficulty one will have in directing the force to the target. Springs can be directed by placing the spring within the tooth undercut, by incorporating a guide into the appliance, or by bonding an attachment to the tooth that will serve as an artificial undercut.

Limits of Simple Removable Appliances

In order to predictably control root position with orthodontic appliances, it is necessary to generate a moment through the use of two point contact. While it is possible in theory to generate two point contact using a simple removable appliance, in practice, predictable root movements are not possible. On the lingual surface, the spring does not stay in contact with the surface of the tooth. On the labial, a heavy activation of the spring is required to generate the moment and it becomes difficult for the retentive elements to keep the appliance in place. In a similar manner, predictable two point contact is a requirement in keeping roots parallel during space closure. Simple removable appliances can tip teeth into open spaces, but bodily movement of teeth using these appliances is not possible. If bodily tooth movement is desired, then fixed appliances are the appliances of choice.

Clinical Procedures

The clinical procedures required for the use of simple removable appliances include:

1. The wax bite
2. The alginate impression
3. The completion of the prescription
4. Insertion
5. Activation
6. Post insertion instructions

Actual laboratory fabrication of the appliance is not covered in this production as it is not a component of the undergraduate program.

1. *The Wax Bite*

The key to the ideally fitting appliance starts with an ideal alginate impression. The ideal impression starts with an ideal wax bite. Ask your patient to practice biting into maximum intercuspation or centric occlusion multiple times. Once they are comfortable, heat a square of pink baseplate wax in warm water for approximately one minute until soft. Roll the square into cylinder. While still warm, bend the cylinder into a horseshoe, or archform shape. In very young patients, it may be necessary to shorten the posterior part of the archform. Have the patient open wide, but instruct them not to bite down until told to do so. Place the wax on the occlusal surfaces of the lower teeth, behind the edges of the mandibular incisors. Stabilize the wax over the molars and have the patient bite slowly and firmly through the wax into full intercuspation. Visualize the overbite and the midline relation of the incisors in order to confirm that the patient is biting into habitual centric occlusion. After approximately ten seconds, remove the wax bite and chill under cool water. To ensure accuracy, look to see that the wax is perforated and that it fits passively back in the mouth when the patient bites his or her teeth together. Use the wax bite as a guide in tray selection.

2. *The Alginate Impression*

Select the appropriate stock metal tray. Trays should fit loosely and comfortably in the patient's mouth. Approximately 3 mm of space should be present all around the tray to allow for a proper thickness of material. The operator should be able to visualize the borders of the tray as they extend into the buccal and lingual vestibules. If the teeth are particularly long or the vestibule deep, orthodontic tray wax may need to be added to the tray to achieve proper extension. As a guideline, the most common maxillary tray is a number 5: the most common mandibular tray, a number 22. Have the patient sitting with relaxed natural head position. Mix either 2 or three scoops of fast set alginate using cool or cold water. Load the tray ensuring a minimum of entrapped air space. Young patients tend to have active gag reflexes, so keep the amount of material to a minimum. Seat the tray slowly and smoothly, extending the soft tissue out of the way, ensuring proper position and adequate seating in the posterior. Seat the posterior first, expressing the majority of the material to the anterior. Once set, carefully break the seal and remove the impression. Allow the patient to rinse. Check the impression. All of the teeth should be visible with a minimum of bubbles in the impression. There should be a smooth roll of material into the mucobuccal folds. If acceptable, wrap the impression in wet paper towel in preparation for pour up within one hour with yellow dental stone. Repeat the procedure in the opposing arch.

3. *Complete the Laboratory Prescription*

Using the appropriate form, clearly draw the appliance design onto the dentaform. Ask your instructor for assistance where indicated. Make sure your instructor has signed the form and that the date of insertion is clearly indicated. Remember, at U of T a minimum of 2 weeks is required for appliance fabrication. Note any unique features of your design on the form. Select wire diameter if desired. Remember to sign your prescription and to thank your technician.

4. *Insertion of the Appliance*

Upon acceptance of your appliance from the laboratory, check the name on the base of the cast to verify that you have the correct appliance. Check the fit of the appliance on the cast. Soak the appliance in an acrylic compatible disinfectant for 30 minutes prior to insertion. Show the patient the appliance and demonstrate the features of your design. Position the patient properly and carefully insert the appliance. Idealize the fit of the appliance by tightening the clasps and bow. The acrylic should seat right up against the palate or lingual soft tissues. If the appliance feels particularly tight, judiciously trim the acrylic with an acrylic bur in a straight handpiece where it contacts the lingual surfaces of the teeth. The appliance should not rock when fully seated in the mouth.

Once satisfied with the fit of the acrylic, tighten the Adams Clasps. These clasps can be tightened two ways. Grip the mesial arm of the clasp with a 139 or a bird-beak plier where it exits the acrylic baseplate. Bend the clasp gingivally a small amount. Repeat the movement on the distal arm and on the contralateral clasp. Retry the appliance in the mouth. It should seat with a slight 'click' and require moderate digital pressure upon removal. Repeat the process until both the patient and you accept the result. The patient may occlude slightly on the clasps, but this is usually self limiting and improves within a few days. An alternate method of clasp adjustment is to roll the clasp gingivally where the clasp contacts the tooth using the same plier. Movement at this location is even less and will easily improve the retention of the appliance. Care must be taken not to distort the shape of the clasp.

Ball clasps may be tightened in the same fashion. Using a 139 or bird-beak plier, grip the clasp where it exits the baseplate and roll it slightly towards the gingival.

Movements here are small. Ensure that there is not excessive blanching of the gingival tissue when seating the appliance.

The last adjustment to be made is the labial bow. The bow should lightly touch the labial surface of the incisors, and rest straight across the teeth in the incisal third of the teeth. Adjustments can be made at the Wilson loop using a 139 or bird-beak plier.

Open or close the loop at the apex of the loop. As the loop is opened, the bow will move gingivally. As it is closed, the bow will move incisally. Compensatory bends may be required either anterior or posterior to the loop to adjust the height of the loop.

Once all of the adjustments have been made, with the aid of a mirror, instruct the patient how to insert and remove the appliance. For the majority of appliances, when inserting a removable appliance, the labial bow should be placed over the incisors and then seated towards the posterior. Fully engage the clasps by applying gentle digital pressure on the labial and the lingual wire and acrylic respectively. Confirm full seating of the appliance visually and verbally by asking the patient. To remove the appliance, have the patient grip the labial wire of the Adams clasp on either side and have them pull inferiorly and anteriorly. Discourage them from using their tongue or from pulling on the labial bow. Repeat instruction until the patient can confidently insert and remove their appliance. Give the patient a retainer case to keep the appliance safe when not in the mouth.

5. *Activation*

Finger springs should be activated once every 4 to six weeks. With a 139 or a bird-beak plier, open the spring in the desired direction using the minimum level of force. The spring is usually activated one millimeter or less. It is important not to over-activate the spring. Too much activation will either cause the spring to deflect upon the surface of the tooth, or will lead to disengagement of the appliance. Continue adjusting the spring until the appliance remains fully seated, and the patient reports light, gentle pressure on the tooth.

Midline screws are activated once a week by the patient. Instruct the patient and his or her parents how to activate their appliance by inserting the key into the glen-ross screw and fully rotating the key to the posterior edge of the appliance. Demonstrate how to remove the key without reversing the activation and be sure that they know how to reinsert the key into the next hole. Once you have finished activation, be sure and deactivate the appliance so it will fit as accurately as possible the first time it is inserted.

Patients with removable appliances should be recalled every 4 to 6 weeks. Once desired tooth movement has occurred, activation can cease and the appliance can be worn as a retainer.

6. *Post Insertion Instructions*

All patients who are given a removable appliance are given the following instructions:

- Wear the appliance full time, except when eating or playing contact sports
- Keep the appliance as clean as possible. Brush it with a toothbrush and toothpaste every time you brush your own teeth, at least twice a day. Rinse it thoroughly with tap water.
- Do not boil it in water. If it needs to be soaked, let it sit for 30 minutes in a bowl with mainly water and a small amount of vinegar.
- Keep it away from the family dog.
- Never wrap it up in a napkin especially in a restaurant. Keep it in the case when it is not in the mouth.
- If lost or broken, contact your student as soon as possible to arrange a follow-up visit.

Research and Clinical Implications

The simple removable appliance has been used in orthodontics for limited treatment for more than 100 years. In the right patient, this appliance offers straightforward correction of minor malocclusion. The appliance is simple to adjust and inexpensive for the patient. While materials and design will continue to evolve the simple removable appliance will continue to occupy a position in everyday orthodontics.