GCS expansion appliance: Fixed-removable expander

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Abstract

This study describes a new fixation system for removable appliances that does not require the fabrication of clasps and is specially recommended for patients whose teeth provide little or no retention. This fixation system, called GCS, uses attachments fabricated with orthodontic buttons bonded to the teeth. It provides excellent mechanical retention, and the removable appliances, in this case an expander, can be activated as if they were fixed appliances cemented or bonded to teeth. An additional advantage is that they may be removed for cleaning and repairs, if necessary. This study also describes a GCS retention appliance that fits into the attachments and fixes the appliance in a certain position, which precludes the use of clasps and may be adapted for practically all active or retentive orthodontic devices as it combines high retentive efficiency and fabrication simplicity.

Keywords: Palatal expansion. Rapid maxillary expansion. Removable expander. Removable orthodontic appliances. Attachments.

INTRODUCTION

According to orthodontic literature, posterior crossbite is one of the most prevalent types of malocclusion in deciduous and mixed dentitions. Its prevalence ranges from 8 to 16% in children in this age group, and unilateral posterior crossbite with mandibular shift is predominant. This occlusal disharmony does not usually self-correct; if not corrected at an early stage, it may affect the development of permanent occlusion, as well as lead to possible asymmetries and condyle displacement.[16,17,18,22,23]

Posterior crossbite may be classified as: unilateral or bilateral; dental, due to poor axial tooth tipping, or skeletal, due to basal transverse maxillary deficiency. Therefore, removable maxillary

How to cite this article: Goulart CS, Thiesen G, Nuernberg NJN. GCS expansion appliance: Fixed-removable expander. Dental Press J Orthod. 2011 July-Aug;16(4):79-86.

» The authors report no commercial, proprietary, or financial interest in the products or companies described in this article.

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expansion appliances are used to correct crossbites with dental origin or with mild skeletal discrepancy.[6,16,21] In contrast, fixed maxillary expanders are used when the objective is to separate the intermaxillary suture, enlarge the maxillary basal bone transversally and, thus, correct crossbite with skeletal origin.[7,8,11]

The greatest advantage of removable appliances is that they may be removed by the patient for cleaning or in accordance to the social occasion. On the other hand, its greatest disadvantages are: Possible poor patient cooperation in wearing the appliance, interrupted tooth movement, lack of appliance fitting and impossibility of applying intense (orthopedic) forces.

In fixed appliances, the pressure built due to activation of the expansion screw generates an orthopedic force that separates the midpalatal suture, and this is the greatest advantage of this appliance, together with the fact that patient cooperation is not as necessary. Among its disadvantages, the impossibility of its removal may result in poor cleaning and lead to irritation of tissues adjacent to the appliance.

Faltin Jr et al[4] described a mixed or semi-fixed appliance for palatal expansion that has a fixed component and a removable part that fits into the acrylic plate which is cemented to the posterior maxillary teeth. According to the author, this method has the advantage of maintaining contact with the palatal surface and providing excellent retention, so that orthopedic forces may be applied for midpalatal suture expansion. Another advantage is that it may be removed for cleaning and possible relief in the palatal region, if necessary.

Removable appliances are the device of choice in the first stages of posterior crossbite correction,[6] and the Haas expansion appliance is usually chosen when there is a skeletal maxillary constriction in the deciduous, mixed or permanent dentition, which corresponds to about 80% of the patients with posterior crossbite that affects two or more teeth.

Therefore, rapid maxillary expansion is a treatment option strongly supported in current orthodontic practice, in which the retention of the expander is important to achieve forces capable of expanding the midpalatal suture. Rapid maxillary expansion is a procedure that has been known for over a century. The first author to report it scientifically, Angell,[1] in 1860, described and used a device with a screw placed transversally to the midpalatal suture and fixed to the teeth of a 14-year-old adolescent.

Since then, several clinical and experimental studies have been described in the literature, and rapid maxillary expansion has become a common method to treat maxillary deficiencies in growing patients by applying intense orthopedic forces.[2,5,9,10,12,13,15,19,20] These levels of force are achieved with the activation of 1/4 to 4/4 of a turn per day, because the amount of maxillary expansion and the effect of the tipping of anchorage teeth are similar in both activation protocols.

The present study describes the manufacture of the GCS expander whose main characteristic is the fact that it is a fixed and removable appliance that can receive the application of greater forces, more compatible with the purpose of obtaining orthopedic changes and that, at the same time, can be removed for cleaning. It also describes a removable appliance that uses a GCS device with a retention wire that supersedes the use of orthodontic clasps.

FABRICATION OF APPLIANCE

Before impression, the attachments are made using the round base of an orthodontic lingual button or crimpled hook (30.21.104, Morelli, Sorocaba, Brazil). The active part is bent so that the device is made on a semi-spherical base of 1.4 mm height silver soldered (Figs 1A and B).

Before bonding the attachments to the lingual surfaces of the teeth that have been previously selected for this purpose these surfaces are

cleaned with a rubber cup and a prophylactic paste without fluoride. The surfaces are then rinsed and dried, relative isolation is placed, and direct bonding is performed using the same composite that orthodontists usually apply for bracket bonding. They use it according to manufacturer's instructions for operative sequence and working time.

After bonding the four attachments (two on each side) (Fig 1C), the composite excesses are removed, the working impression is produced using Coltoflax/Coltex (Coltène, Altstatten, Switzerland) and the mold is poured with type IV plaster (Fig 1D).

The expansion screw is selected according to the space available between arches and also the amount of expansion necessary. The plastic rod is removed and the screw is activated 10 times to about 2 mm opening. This previous opening is necessary so that the screw has no activation and the appliance width is reduced for the insertion and removal of the GCS expander. After initial activation, the space in the center of the screw is filled up with wax (Fig 1D) to avoid the flow of acrylic resin into this space, which would complicate finishing.

The plaster mold is isolated using Cel-lac (SS White, Rio de Janeiro, Brazil), and the screw is placed transversally over the midpalatal raphe to enable the anterior to posterior activation.

The self curing acrylic resin is prepared and placed in the plaster mold to make the palatal portion of the device, which extends to the middle of the lingual surface of all teeth (Fig 1E) and reproduces and involves all the attachments, particularly in the cervical portion, to ensure the best possible fitting and, therefore, optimal retention. Final resin curing is performed under pressure. The device is then removed from the mold for finishing and polishing.

The expander is sectioned in the anteroposterior direction using a carbide disk to produce two parts united by the expander screw. The gap between the acrylic margins should be 2 mm wide so that the screw has no activation and the device can be closed transversally to be inserted or removed.

A relief in the acrylic should be produced in the portion that corresponds to the tip of the screw by placing a small wax ball before curing, or after that by drilling the acrylic material; this will ensure that the expander will close. The portion that is in contact with the buttons should not be drilled to ensure optimal fitting in this area.

APPLIANCE PLACEMENT

The screw must be totally deactivated because of the 1.4 mm increase in volume resulting from the bonding of buttons on the lingual surface of teeth: The first ten activations to put the expander in position should be undone.

The GCS expander is inserted first on one of the sides of the arch and fit into the attachments. After that, the opposite side is put in position and the screw is activated 10 times, so that the expander returns to its original width and fits into the attachments perfectly.

EXPANDER ACTIVATION

Activations should start in the morning after the expander placement allowing the patient to have time to adapt to its use, this way the discomfort at swallowing and speaking is reduced. Activations should be performed daily according to the same protocols used for fixed expanders, that is, 1/4 of a turn per day, or 1/4 of a turn in the morning and 1/4 in the evening, or 2/4 in the morning and 2/4 in the evening, depending on the individual sensibility of each patient. We prefer the 1/4 activation in the morning and 1/4 in the evening. The active expansion phase is completed when there is a transverse overcorrection of 2 to 3 mm.

EXPANDER REMOVAL

The GCS system allows the device to be removed daily for cleaning: Ten activations of the screw should be undone, and the device should

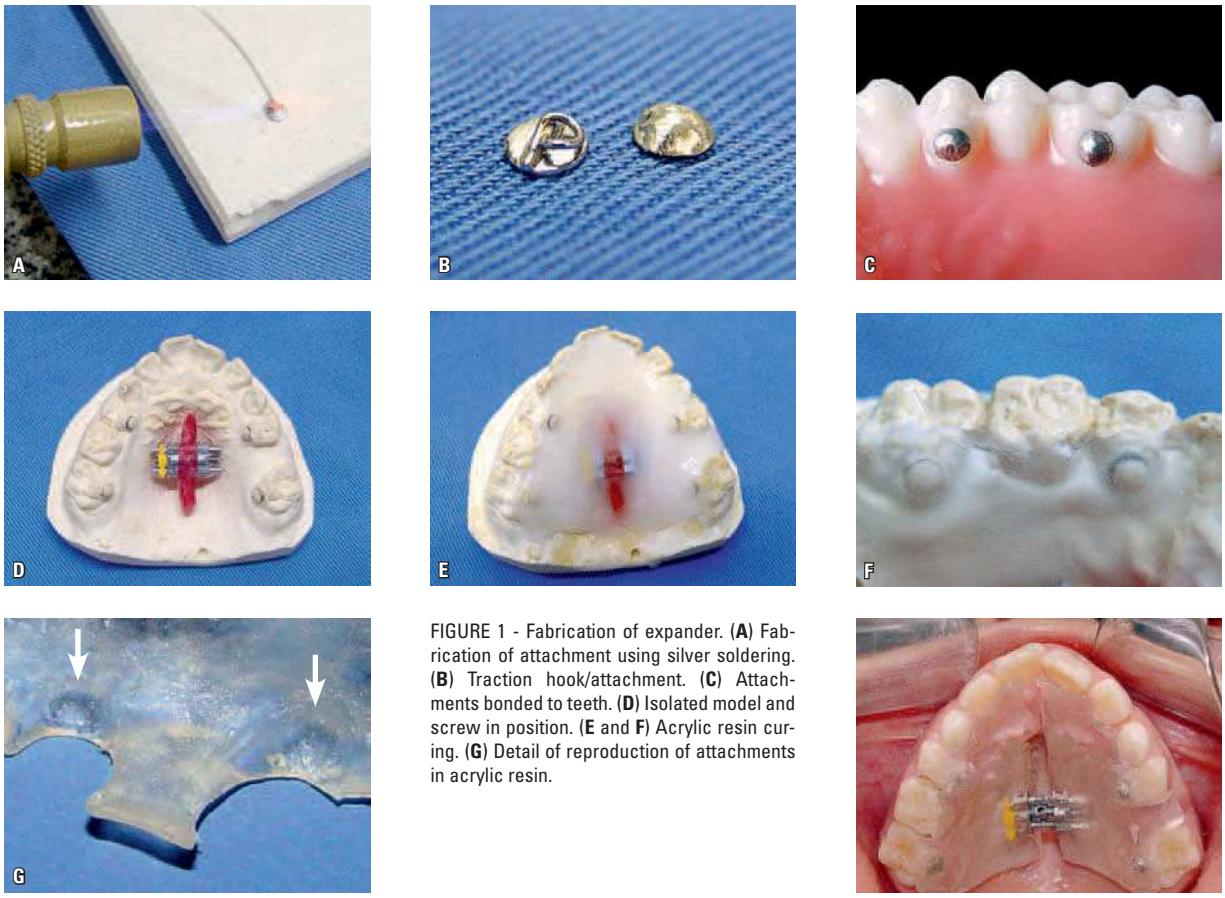

FIGURE 1 - Fabrication of expander. (**A**) Fabrication of attachment using silver soldering. (**B**) Traction hook/attachment. (**C**) Attachments bonded to teeth. (**D**) Isolated model and screw in position. (**E** and **F**) Acrylic resin curing. (**G**) Detail of reproduction of attachments in acrylic resin.

FIGURE 2 - Expander placement.

be removed in the occlusal direction. After the oral hygiene, the expander is repositioned and the screw activated 10 times to return to the level of opening achieved before removal. If necessary, it may be then activated 1/4 or 2/4 of a turn, according to the protocol used.

RETENTION

When the amount of desired expansion is achieved, the expander may be kept in place for retention. For that purpose, the screw is fixed with acrylic resin to avoid its closing. The acrylic material below the midline of the attachments should be slightly drilled to ensure the device's easy insertion and removal. Another option is to make a GCS wire retainer, which provides excellent retention and is easy to remove. A new impression and working cast should be prepared to make the retention device.

Before curing, a piece of 0.024-in steel wire (55.05.560, CrNi elastic hard wire, Morelli, Sorocaba, Brazil) is fixed with wax to the cervical portion of the attachments. The ends of the wire should be included in wax to remain free after curing (Fig 3). This wire retainer works as a stop, that is, the wire deflection during insertion should

allow the passage of the device at the equator of the attachment where the retention wire will lock the device.

The model is isolated with Cel-lac (SSWhite, Rio de Janeiro, Brazil), and then the acrylic material is prepared and poured into the model to completely include the steel wire and cover the attachments. After curing, the device is trimmed and polished as usual (Fig 3D).

The GCS system provides an efficient retention, and it can only be removed if some anchoring device is used to support its removal. If the device has a Hawley archwire or a palatal crib, they may be used to help removing the retainer. Otherwise, a round clasp may be placed on one side of the appliance only to help removing it (Fig 6B).

CLINICAL CASE

Figure 4 illustrates the case of a 9-year-old girl that had functional posterior crossbite, anterior open bite and tongue interposition. A previous attempt to correct the malocclusion was not successful because teeth provided little retention and the patient was uncooperative, as she removed the appliance for most of the day. A GCS expander was placed, and the parents were told to activate it 1/4 of a turn in the morning and 1/4 in the evening for 12 days. The expander was removed every day at night for cleaning and placed back after that. After the crossbite correction, a GCS retainer with a retention wire and palatal crib was used to avoid relapse and to correct the open bite.

Figure 5 shows an 8-year-old girl. Her clinical examination revealed bilateral posterior crossbite. A previous treatment attempt failed because the patient removed the expander for meals and forgot to place it back, in addition to removing it at night. A GCS expander with a buccal archwire was placed. The expander was activated 1/4 of a turn in the morning and 1/4 in the evening for 14 days. The expander was removed every night for cleaning and placed back after that. The incisors were separated (Fig 5E), and the radiograph showed the amount of palatal suture separation obtained (Fig 5F).

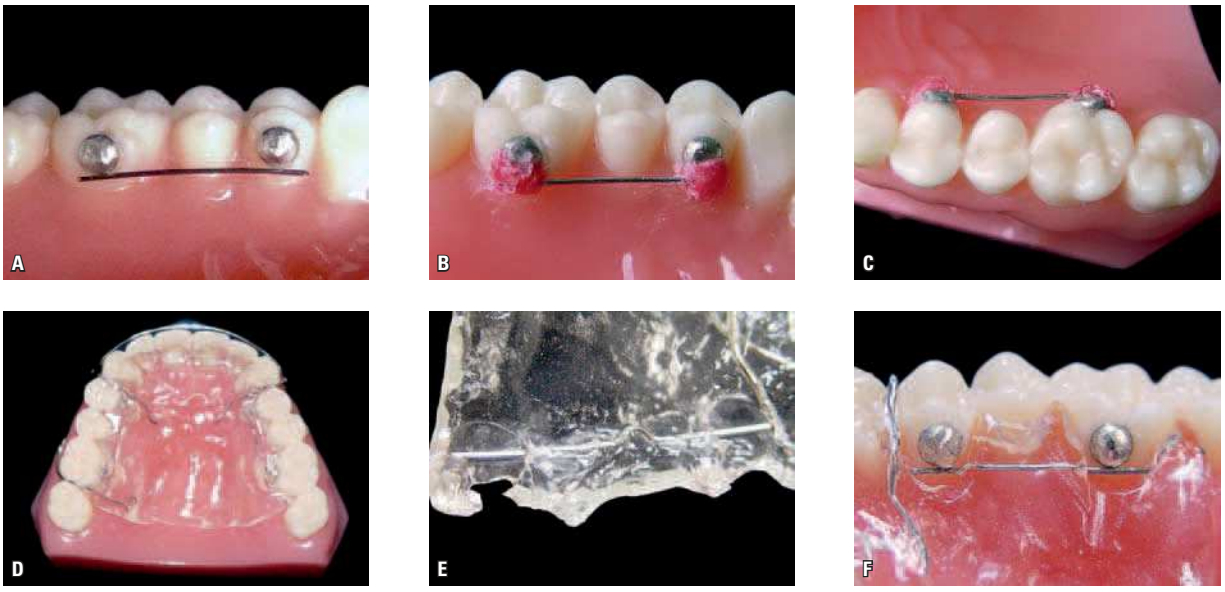

FIGURE 3 - Fabrication of retention device (**A, B** and **C**), 0.024-in steel wire positioned in attachments, wax application for wire fixation and production of space in acrylic resin for activation. (**D**) Retention. (**E** and **F**) Detail of attachment slot and retention wire.

FIGURE 4 - 9-year-old girl. Functional posterior crossbite, anterior open bite and tongue interposition. GCS expander placement. Activation of 1/4 of a turn in the morning and 1/4 in the evening for 12 days. GCS wire retainer and palatal crib. (**A**) Frontal view. (**B**) Occlusal view. (**C**) View after correction. (**D**) GCS retainer with palatal crib.

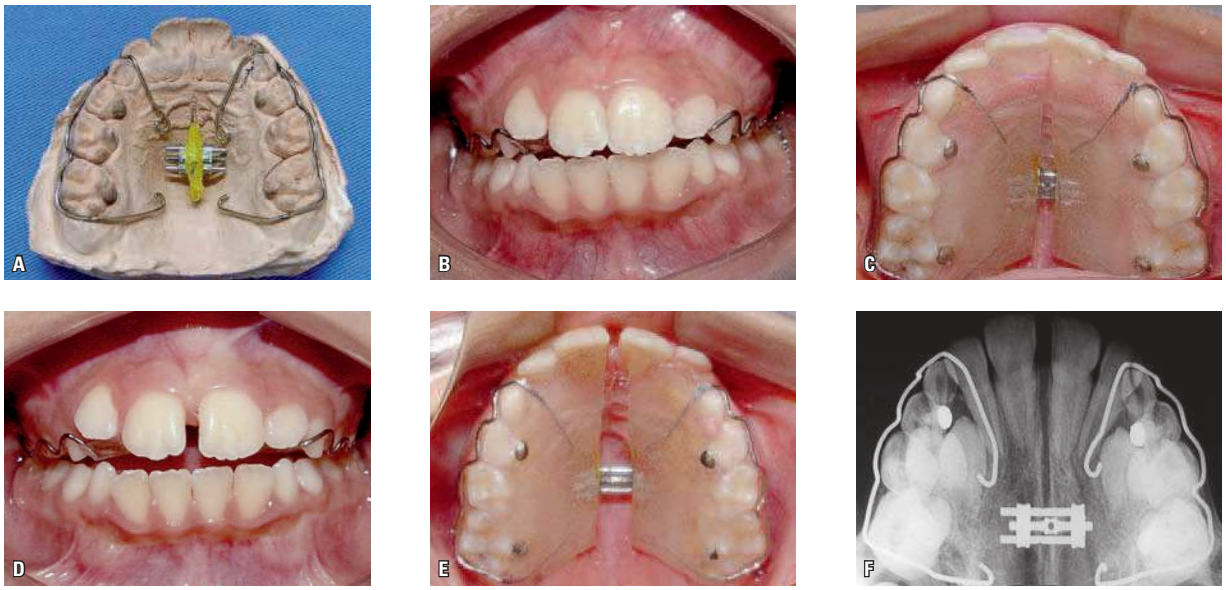

FIGURE 5 - 8-year-old girl. Placement of GCS expander with buccal archwire. Activation of 1/4 of a turn in the morning and 1/4 in the evening for 14 days. Incisors were separated; radiograph shows separation of palatal suture.

Figure 6 shows a GCS expander with indirect bonding of the attachments simultaneously with the placement of the appliance in a 8-year-old female patient that presented at the clinical examination a bilateral posterior crossbite with little space for the correct alignment of the lateral incisors. Parents were asked to activate 1/4 of a turn at the morning and 1/4 of a turn at night for 16 days. The removal of the appliance for cleaning was performed every 2 days.

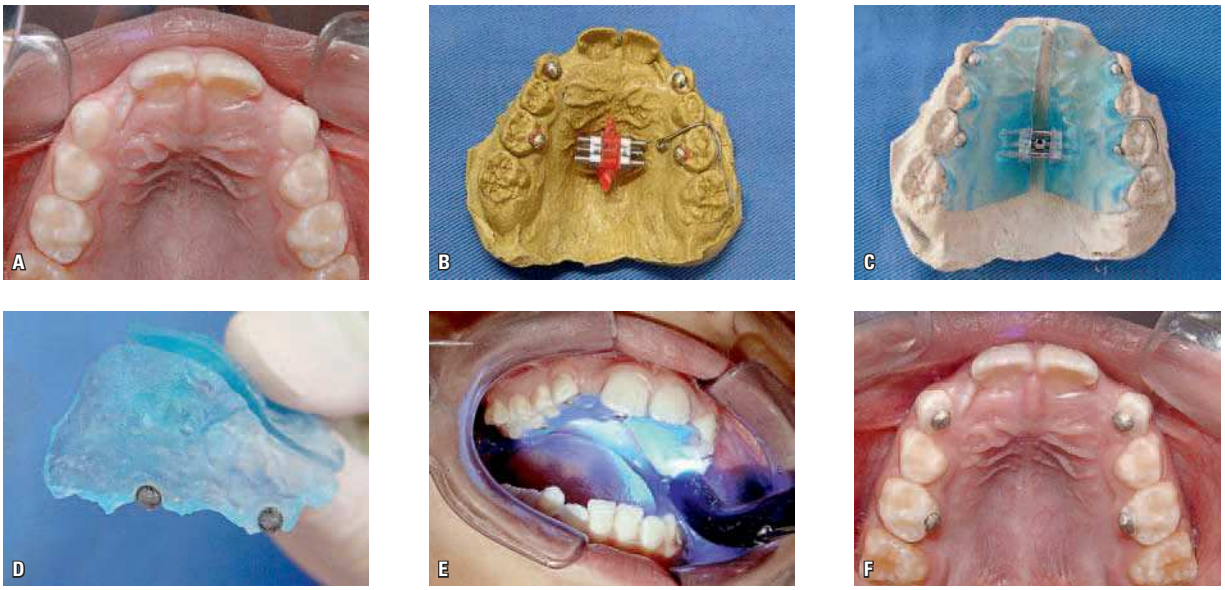

FIGURE 6 - 8-year-old girl with maxillary atresia. Fabrication of GCS expander and indirect attachment bonding. (**A**) Occlusal view. (**B**) Attachments bonded to model, pre-activated screw and clasp to help removing the appliance. (**C**) Expander with acrylic resin. (**D**) Buttons bonded to appliance with sticky wax for indirect bonding. (**E**) Resin light curing. (**F**) Attachments bonded to teeth.

FINAL CONSIDERATIONS

The GCS fixation system, both the GCS expander and the CGS retainer, was efficient in clinical practice, particularly because it provides excellent retention in all cases.

The GCS expander combines the characteristics of a fixed appliance and is practical like a removable appliance. Rapid palatal expansion may be achieved without the need of orthodontic bands. The appliance can be removed for cleaning when inactivated because of its attachments and characteristics. However, its removal is not possible at any time, as is the case with conventional removable appliances, which avoids that children, for example, remove it and don't place it back when not under their guardian's supervision, which rules out the most common cause of poor adherence to treatment with removable appliances.

The GCS wire retainer supersedes any type of orthodontic clasps, particularly in cases of teeth that provide little or no retention, such as in deciduous and mixed dentitions. In some cases, only two attachments provide retention similar to that provided by a Hawley retainer.

The fabrication of GCS appliances takes less laboratory time and simplifies the production of orthodontic devices. Attachments may be previously made by the orthodontist, but we believe that, as this technique becomes popular, soon they will be produced and sold as orthodontic accessories by the companies that operate in this market.

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Submitted: August 7, 2007
Revised and accepted: December 5, 2009

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