



## Review Article

# Retention protocol following post-orthodontic treatment in cleft palate patients – A review

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## ABSTRACT

**Aim:** To evaluate and compare the available literature on efficiency of different retention appliances in maintaining the results achieved after orthodontic treatment in cleft palate patients.

**Result:** On comparing the literature available on different retention appliances currently available, it was found that the cast metal retainers offered a more stable and rigid design to maintain the post treatment arch width and also provided the aesthetic replacement of the missing teeth in the cleft region by incorporating a pontic.

**Conclusion:** The cleft lip and palate patients should be informed and motivated for a long term or indefinite retention phase irrespective of the type of retention appliance used. Presently, very few studies are available comparing the effectiveness of different retention protocols in cleft lip and palate patients. Hence, there is need to conduct evidence based high quality longitudinal studies to compare the effectiveness of different retention appliances.

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## 1. Introduction

Cleft lip and palate are the most common congenital birth defects of the craniofacial region characterised by complete or partial cleft of the lip and/or palate. The worldwide incidence of cleft lip and palate is 1 in 700 and its incidence in Asian population is reported to be approximately 2% per 1000 live births.<sup>1</sup> The aetiology of the cleft lip and palate is considered to be multifactorial with potential contributing factors including both genetic and environmental influences.<sup>1,2</sup>

Patients with cleft lip and palate encounter a great multitude of problems. This ranges from functional impairment such as impairment of suckling, swallowing, speech and hearing, facial disfigurement and malocclusions. They also suffer from psychological and sociological

trauma that have a deep-rooted impact on children and parents.<sup>2-4</sup>

The treatment of cleft lip and palate is commenced soon after birth which is continued upto adulthood. The optimum approach to treat the children born with cleft defects is a multidisciplinary approach which includes a team of paediatrician, orthodontist, radiologist, anaesthesiologist, plastic surgeon, maxillofacial surgeon, prosthodontist, neurologist, neurosurgeon, psychologist, psychiatrist, and an ear-nose-throat (ENT) specialist.<sup>2,5</sup> In patients with unilateral or bilateral cleft of lip, alveolus and palate, orthodontic treatment is required during the following four stages:

1. In an infant: Neonatal maxillary orthopaedics
2. During the primary dentition: Orthodontic-orthopaedic treatment
3. During mixed dentition: Orthodontic treatment

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4. In the permanent dentition: Orthodontic treatment alone or in tandem with orthognathic surgery.<sup>2,5,6</sup>

Cleft lip and palate are often associated with maxillary hypoplasia which may occur due to various factors such as congenital defect, traumatic effect, surgeries or constriction of scar tissue leading to moderate to severe crowding, missing teeth and anterior and posterior crossbite.<sup>7</sup> After the upper arch expansion, relapse usually occurs especially in the canine and premolar area. One of the main objectives of the orthodontic treatment is to achieve orthodontic alignment of the dentition. This is facilitated by the secondary alveolar bone grafting during the late childhood period (i.e., during late mixed dentition, early permanent dentition). Steady improvement in the bone grafting procedures over the years have led to the increased success rate of grafts, hence, enhancing the degree of post treatment stability by providing bone for successful stabilization of dentition in grafted area.<sup>8</sup>

Moyers described Retention as “maintaining newly moved teeth in position long enough to aid in stabilizing their correction”. In orthodontically treated cleft lip and palate patients, retention following the removal of fixed appliances is of paramount importance mainly due to hypodontia, transverse arch discrepancies, ridge defect including an oronasal fistula and lack of ideal bone support for the teeth adjacent to the cleft defect. Hence, a retainer should be immediately placed after the removal of fixed orthodontic appliances on the same day.<sup>2,9,10</sup> The design of the retention appliance for the cleft patients should fulfil the following requirements:

1. Provide long term fixed retention after orthodontic therapy.
2. Should be able to maintain post-treatment arch form.
3. Should be capable of achieving three-dimensional control of all teeth.
4. Should be capable of incorporating pontics and replacing missing teeth.
5. Rigid and sturdy design.
6. Superior aesthetic appearance – retainer should not extend to the facial surface.
7. Easily and economically fabricated.
8. Durable and biocompatible.
9. Should allow occlusal settling.
10. Should have ability to splint periodontally weakened teeth.<sup>11</sup>

Various Retention appliances that have been used following the completion of orthodontic treatment in cleft lip and palate patients are Modified Hawley’s appliance in the maxillary arch and 3 x 3 fixed retainer in mandibular arch, Vacuum formed clear retainers (Essix retainer) and cast metal fixed retainers.

## 2. Discussion

### 2.1. Modified hawley’s appliance

Hawley retainer was first introduced by Charles Hawley in the year 1919.<sup>12</sup> It consists of acrylic baseplate and wire components as either short or long labial bow made from 0.7 mm stainless steel wire and clasps for retention. In case of cleft palate patients, the acrylic plate is modified to include prosthetic teeth in missing teeth space which would be later replaced with dental implants or prosthesis shown in Figure 1.<sup>13,14</sup> Sauget in 1997 found that Hawley retainer demonstrated a significant increase in the number of occlusal contacts compared to the clear retainers.<sup>15</sup> Similar result was reported by Basciftci et al., 2007 when they evaluated the number of contacts in centric occlusion during a 1-year retention period with different retention procedures.<sup>16</sup> Gill and colleagues (2007) reported that a rigid Hawley-type retainer was more effective for the maintenance of arch expansion in cases requiring significant expansion.<sup>17</sup> In a study conducted by Jin in 2018, it was reported that lingual fixed retainers and Hawley retainers have the longest survival followed by combination retainers and vacuum-formed retainers.<sup>18</sup>

Gardner LK in 1996 reported a case of a 16-year-old patient who underwent surgical repair of lip, alveolus, and palate for a bilateral cleft lip and palate along with orthodontic correction of her permanent dentition. A conventional palatal coverage using a removable partial denture framework with ball clasp retention was used to seal the remaining small fistulae in the palate and alveolus. It served as both a retainer and as replacement for the four incisor teeth (Figure 2).<sup>5</sup>

Singh S (2017) observed that in many growing patients there was failure of eruption of teeth in the grafted cleft area of the maxilla and hence, revised the retention protocol to include a fixed bonded retainer on all teeth adjacent to the cleft in addition to the post orthodontic removable retainer. But yet it has not been completely successful in controlling the vertical relapse.<sup>19</sup>

### 2.2. Advantages

1. Removable type, hence, easy to maintain oral hygiene
2. Allows for occlusal settling<sup>15,16</sup>
3. Can be easily fabricated, cleaned and repaired if broken
4. Economical

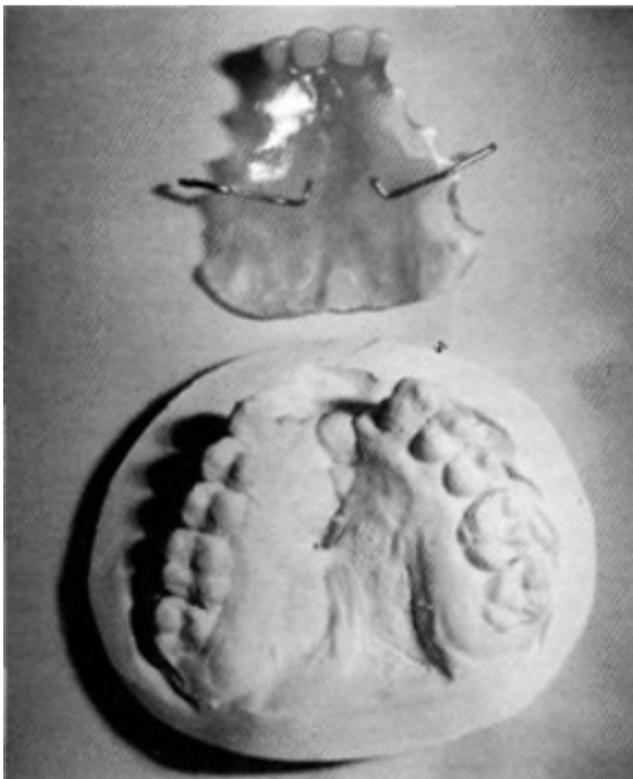
### 2.3. Disadvantages

1. Prone to relapse due to the negligence of patient to wear the retainers.
2. Aesthetically inferior to transparent retainers due to the visibility of labial bow made of stainless steel on facial surface.<sup>20,21</sup>

3. Difficulty in adapting to the appliance initially.<sup>20,21</sup>
4. Hypersalivation, taste alteration
5. Difficulty in speech articulation<sup>22</sup>
6. Frequent breakage with the appliance



**Fig. 1:** Modified hawley retainer in a unilateral cleft palate patient incorporating pontic for left lateral incisor



**Fig. 2:** Bilateral transitional removable partial denture.

### 3. Vacuum-Formed Retainers

It was first designed by Ponitz in the year 1971<sup>23</sup> and further developed by Sheridan (1993).<sup>24</sup> In the literature, it has also been referred to as clear overlay retainers (CORs), Vacuum-Formed Retainers (VFRs), or Essix retainers. It is made of thermoplastic material like polyethylene polymers and polypropylene polymers. Polyethylene polymers are more aesthetic, transparent,

and allow bonding to acrylic while, Polypropylene polymers, on contrary, are aesthetically inferior and translucent but more durable and flexible compared to polyethylene polymers.<sup>25,26</sup> VFRs are preferred by patients due to their appearance, comfort, and superior aesthetics.<sup>20,27–30</sup> Hichens et al. in their study concluded that less embarrassment was caused by VFRs in terms of speech and appearance as compared to Hawley retainers.<sup>22,29</sup> A similar result of VFRs being more compliant than the Hawley retainer was reported by Pratt et al.<sup>31</sup> Rowland et al. concluded that when compared to Hawley retainers, VFRs are more effective in holding corrections of the maxillary and mandibular labial segments.<sup>32</sup> Mai et al. in 2014 conducted a systematic review to compare vacuum-formed and Hawley retainers and concluded that after active orthodontic treatment there are no differences in respect to changes in intercanine and intermolar width between VFRs and Hawley retainer.<sup>20,30,33,34</sup> O'Rourke N et al. (2016) stated that when compared to vacuum formed retainers, bonded retainers are more effective in maintaining incisor alignment in the mandibular arch in the first 6 months after debonding of fixed appliances.<sup>35</sup>

#### 3.1. Proposed advantages of the VFR includes

1. Superior aesthetics
2. Better patient comfort and acceptability;
3. Speed and ease of fabrication
4. Efficient in preventing unwanted movements of the labial segments

#### 3.2. Disadvantages

1. Loss, breakage and poor wear resistance<sup>34,36</sup>
2. Hinders any desired vertical 'settling-in' of the occlusion subsequent to active orthodontic treatment;
3. Inefficient in maintaining transverse maxillary arch expansion due to its lack of rigidity;<sup>1</sup>
4. Inability to restore hard and soft tissue deficits in alveolar cleft sites;<sup>11</sup>
5. Inability to adequately maintain edentulous spaces prior to construction of definitive prostheses.<sup>11</sup>
6. Since it is a removable type retainer, its efficiency depends on patient's compliance.
7. Relies on mechanical retention of the pontic.<sup>11</sup>

Due to these above-mentioned disadvantages, vacuum formed retainers are not considered to be ideal for maintaining the arch form in the orthodontically treated cleft patients.

In order to overcome its inability to maintain the expanded arches, Chudasama D. and Sheridan JJ (2010) designed a modified VFR with a transarch stabilizing wire as shown in Figure 3. Here the Essix retainer was improved by incorporating a 0.32-inch stainless steel wire which was bent into "U" shape and placed on the lingual surface of

patient's cast, a few millimetres below the cervical line. 0.5 mm mound of composite was built in order to hold the wire slightly away from the surface of cast. This wire becomes an integral part of the retainer by getting encapsulated into it.<sup>37</sup>



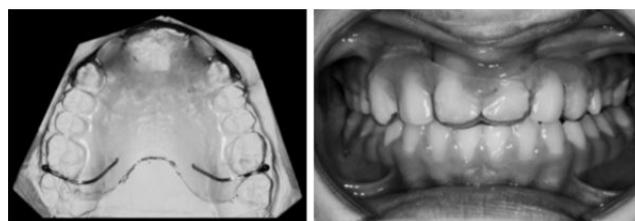
**Fig. 3:** Transarch stabilizing wire for essix retainers

### 3.3. The “Aesthetic” or “Hawlix” retainer<sup>11</sup>

Collins JM et al in 2010 reported a removable retainer with a hybrid design having features of both Hawley and Essix retainers. A close fitting Essix material is incorporated over the labial segment of teeth which allows for the vertical settling of the buccal segment and has an acrylic baseplate with clasp of various design such as ball end clasp in the buccal segment in the similar manner as that of Hawley retainer which helps to control the arch form and width.

Following advantages of the Hawlix retainer over Hawley and Essix retainer were reported:

1. Aesthetically superior - Wire components are not visible anteriorly, an advantage over traditional Hawley retainers.
2. Pontics can be chemically bonded to the acrylic plate and can be incorporated on the external surface of the retainer – helps to prevent the ingress of bacteria and oral fluids between the shell and the pontic,
3. Pontics can be also be adjusted occlusally as necessary without perforating the retainer shell.
4. Helps to replace hard and soft tissue defects. Pink acrylic is placed around the pontics to create prosthetic soft tissues and mimic normal gingival architecture, which is especially useful in masking alveolar cleft defects.
5. Permits occlusal settling – Since the occlusal surfaces are not restricted, the posterior teeth are free to vertically erupt and settle if necessary.
6. Maintenance of Transverse Arch Relationships- Acrylic base plate offers rigid transverse control in maxillary arch where expansion has been carried out.
7. Can Be Worn while eating.

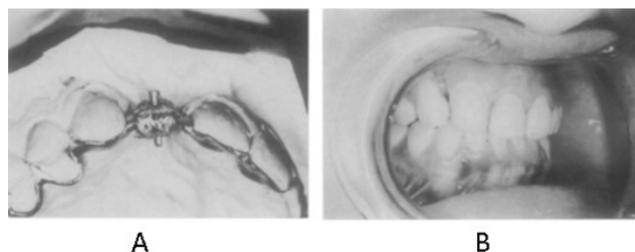


**Fig. 4:** A, Hawlix retainer on a plaster model; B, Hawlix retainer in patient with bilateral alveolar cleft defect

### 3.4. Resin-bonded retainers with custom-made precision attachment for anterior alveolar ridge defect<sup>36,38,39</sup>

Cohen et al (1987) reported a conservative approach for the replacement of anterior teeth associated with an anterior alveolar ridge defect in a 17 year old patient with unilateral cleft lip and palate. The design consists of a resin-bonded retainer which is used as the fixed partial denture segment, and a modification of the Andrews type bridge which is used for the removable segment.<sup>36</sup>

**Fabrication:** The resin-bonded retainer is combined with a custom-made pin attached to a removable acrylic resin prosthesis. The metal framework connecting the two sections across the defect is flat, 2 mm thick and has a vertical slot on the lingual surface. A cylinder extends from the lingual to the labial at the bottom of the slot. The flat metal substructure is covered by the suprastructure casting and has bead retention for the acrylic resin. There is a hole on both the labial and lingual surface of the casting at the same level as the cylinder in the substructure when they are in position. The suprastructure is retained in place on the substructure using the pin. (Figure 5 A). After verifying the fit of the retainers and the suprastructure in the mouth, the removable segment is then processed with heat-cured acrylic resin. The resin bonded retainer is etched and bonded to the teeth with Comspan material. The patient can insert and remove the removable prosthesis by using her fingernail to release the pin (Figure 5 B). The overdenture is removed for cleaning and to facilitate oral hygiene.



**Fig. 5:** A, Suprastructure over substructure with pin in position; B, Clinical view of completed prosthesis.

#### 4. Dual Appliance<sup>39,40</sup>

In the year 2010, Dr. Patil Basanagouda C. et al. designed a Dual appliance in an orthodontically treated cleft palate patient. It was a fixed cast metal retentive appliance incorporating a pontic for functional and aesthetic replacement of the missing teeth and was bonded to the lingual aspect of the teeth as shown in Figure 6.<sup>40</sup>

Advantages of Cast Metal fixed retainers over other retentive appliances in cleft patients are:

1. Rigid and sturdy appliance – maintains the stability of the corrective procedures in cleft patients after orthodontic treatment.
2. Pontic can be incorporated to replace the missing teeth
3. Patient compliance is not needed
4. Aesthetic as it is bonded on the palatal surfaces of maxillary teeth
5. Cost effective
6. Fabricated in lab, hence reduces the chair side time
7. Missing tooth can be replaced without resorting to any invasive procedures for placement of implants with bone graft or extensive crown cutting for placement of Fixed partial denture.<sup>36,39,40</sup> The only drawback of this appliance is that it cannot be placed in cases when an obturator is required.<sup>40</sup>



**Fig. 6:** A, Fixed cast metal retentive appliance in a unilateral cleft palate patient; B, Incorporation of pontic for replacement of missing teeth.

#### 5. Conclusion

The cleft lip and palate patients should be mentally prepared for a long-term or indefinite retention phase following orthodontic treatment to prevent relapse. Among all the retention appliances discussed above, the cast metal fixed retainers fulfill most of the criterias required for maintaining the results obtained by Orthodontic treatment in cleft palate patients. Due to its rigid and sturdy design, it maintains the post-orthodontic treatment arch width and also provides functional and aesthetic replacement of the missing teeth in the cleft region. Being a fixed type of retainer, its effectiveness is not dependent on the patient's compliance.

Hence, after assessing the currently available data, it can be concluded that cast metal retainers can provide

better retention results in cleft lip and palate patients post orthodontic treatment and can be preferred over other orthodontic retention appliances.

However, currently, very few studies are available comparing the effectiveness of different retention protocols in cleft lip and palate patients. Hence, there is need to conduct evidence based high quality longitudinal studies to compare the effectiveness of different retention appliances.

#### 6. Source of Funding

None.

#### 7. Conflict of Interest

None.

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