



Space Regainers : A review of literature

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ABSTRACT:

Premature loss of primary teeth, particularly second molars, often leads to significant arch space reduction, causing eruption disturbances such as impactions or ectopic eruptions of permanent teeth. In paediatric dentistry, space regaining appliances are essential tools to re-establish lost arch space and guide the proper eruption of permanent successors. This review explores the comprehensive range of fixed and removable space regainers, their biomechanical principles, clinical applications and limitations, providing guidelines for their use.

1. Introduction

The early loss of primary teeth has long been associated with space loss and subsequent malocclusion. Hoffding and Kisling (1998) observed that premature loss of primary molars can result in mesial migration of adjacent teeth, thereby reducing arch space and potentially leading to impaction or malposition of permanent teeth. The loss of primary second molars, in particular causes more significant space closure than the loss of primary first molars. In such cases where space loss occurs, a space regainer is routinely needed. Various appliances can assist in both regaining the lost space and maintaining it for the eruption of the permanent tooth. At the initial appointment, the appliance is activated to regain the lost space and then kept passive until the tooth erupts into the oral cavity. This dual function of the appliance helps reduce costs for the parents and saves time for both the dentist and the patient. When an early loss of a primary tooth occurs, corrective measures such as passive space maintenance, active tooth guidance with space regaining, or a combination of both may be necessary to optimize the normal process of occlusion development. ⁽¹⁾

2. Objectives

To provide an elaborate review of fixed and removable space regainers in paediatric dentistry, focusing on their biomechanics, clinical applications, limitations.

3. Results

Coils in Space Regaining :

Stainless steel orthodontic coil springs are affordable and designed to exert sufficiently high forces to move a patient's teeth, including posterior teeth like molars. However, they struggle to maintain high applied force over an extended range of spring action. As the teeth begin to move, the applied force from these springs rapidly diminishes, necessitating frequent replacements to achieve proper tooth realignment. Additionally, stainless steel springs often undergo permanent deformation quickly and contain elements such as nickel, which can cause adverse reactions in some patients. They also contain nickel, which can be allergenic. ⁽²⁾

The concept of NiTi coil springs was introduced in 1975. NiTi orthodontic coil springs are made from alloy wire



with shape memory, providing excellent super-elasticity and spring-back properties. They can maintain a constant load value throughout a zone of deflection. The open coil springs produce light, continuous forces over a long range of activation, although the forces are slightly below the optimum 75-100 g range. NiTi coil springs can deliver a constant force over a range of 7mm tooth movement with one activation. They can be used throughout the arch and typically require few activations, possibly only one, to achieve the desired tooth movement. (3,4)

If the coil spring is to be used as an open or compression coil spring, they are compressed from their initial length of 15mm to 6mm. The closed or tension coil spring are distracted from their initial of 3mm to 6mm. (5)

Types of Space Regainers :

Fixed Space Regainers :

1)Open Coil Space Regainer (OCSR): The fabrication process of the OCSR is similar to that of the sliding loop regainer. However, in the "U" loop of the appliance, sufficient solder is applied to create a stop at the junction of the straight and curved parts of the wire, both buccally and lingually. This contrasts with the occlusal stop in the sliding loop appliance, which prevents the rotation of the first premolar. The limitation of this appliance is that it is not possible to control the axial inclination of the tooth being moved, and tipping may occur. A limitation of this appliance is its inability to control the axial inclination of the tooth being moved, which may result in tipping. (6)



Fig 1: Open Coil Space Regainer (OCSR)

(Image Courtesy : Da Costa GC, Chalakkal P, Aras MA, Chitre V. Use of the Open Coil Space Regainer for Tooth Movement Prior to Prosthodontic Treatment. J Clin Diagn Res. 2015 Jun;9(6):ZJ03-4. doi: 10.7860/JCDR/2015/12356.6045. Epub 2015 Jun 1. PMID: 26266240; PMCID: PMC4525631.)

2)Gerber Space Regainer: A band is prepared and fitted for the abutment tooth and the mesial surface is marked for the placement of the "U" loop, which can be stabilized by welding or soldering. The Gerber space regainer operates on the same principle as the open-coil and sliding loop regainers. In this device, weldable tube stops are soldered onto the U bend of the wire, and open coil spring sections are cut to fit over the wire between the "stops" and the ends of the "U" loop. The springs are loaded and floss is tied through an eyelet and over the "U" wire to hold the stored force in the compressed spring. The springs are compressed so that the assembly fits into the edentulous space. Once the assembly is cemented in place, the floss is cut and removed to activate the regainer. (7)



Fig 2 : Gerber Space Regainer

(Image Courtesy : Shah, Vaishnavi Umesbbhai; Dave, Bhavna HareshL.; Shah, Susmita Shrenik1; Shah, Paridhi Samir. Space Management with Gerber Space Regainer. Journal of Integrated Health Sciences 9(1)p 33-35, Jan-Jun 2021. | DOI: 10.4103/jihs.jihs_8_21)

3)Double Banded Space Regainer: In this appliance, both teeth adjacent to the edentulous area are banded to avoid the possibility of tipping, unlike when only one tooth is banded. **Chalakka P et al., (2012)** reported using a "Double Banded Space Regainer" in the maxillary arch. Early exfoliation of the left second primary molar had led to the mesial migration of the permanent left first molar, resulting in a 3.5 mm space between it and the primary left first molar. Space regainers were fabricated for both arches. In the maxillary arch, after 6 months, the space gained was 5.1 mm with the use of the "Double Banded Space Regainer." In the mandibular arch, after 5 months, the space gained mesial to the first-left premolar was 4 mm, improving the canine space to 7 mm. (8)



Fig 3 : Double banded space regainer

(Image Courtesy : Chalakka P, Thomas AM, Akkara F, Pavaskar R. New design space regainers: 'Lingual arch crossbow' and 'Double banded space regainer'. J Indian Soc Pedod Prev Dent 2012;30:161-5.)

4) Gurin Lock Space Regainer: Gurin Lock space regainer is a unilateral fixed space regainer. It is indicated when mesial movement of the bicuspid is required without distal movement of the other teeth. The device consists of bands on the first premolar and molar, with a sliding bar soldered to the premolar band. The bar slides into a buccal tube on the molar. This appliance uses a nickel-titanium coil spring, which is activated by an adjustable Gurin Lock to regain space without tipping or rotating the teeth. The amount of reciprocal movement of the molar distally and the bicuspid mesially will be influenced by the proximity of the adjacent teeth. To restrict the movement of one of the abutment teeth, additional anchorage is needed. This is achieved using a jackscrew with labial/lingual arch wires. The Gurin Lock is activated with a special box wrench. (9,10)



Fig 4 : Gurin Lock space regainer (Image Courtesy : SML – Space Maintainer Laboratories)

5) Pendulum Appliance: The pendulum appliance can be utilized for unilateral or bilateral distalization of maxillary first molar teeth when mesial drift of upper first molars occurs due to the early loss of primary molars. It is also effective in non-extraction treatment for mild to moderate crowding. The pendulum appliance consists of an acrylic plate that is retained either by clasps to the first premolars or integrated with a metal frame soldered to bands on the first premolars. Distalization arms or springs are made from 0.6 mm stainless steel round-wire that includes a closed helix and a U-loop. The closed helix allows for the activation of the distalization arms, while the U-loops are placed mesial to the molars for adjusting the axial inclination during distalization. This wire is soldered to molar bands. Typically, an initial activation of 60° to 70° (approximately the width of one molar) generates 250g of force per side. The appliance is activated extra-orally and cemented in place. It is monitored monthly, where it is removed for reactivation and re-cementation with luting glass ionomer cement (GIC). The advantage of this appliance is its reduced dependency on patient compliance. It is easy to fabricate and allows for the correction of minor transverse and vertical molar positions through spring adjustments. Patients generally accept the appliance well. (11,12)

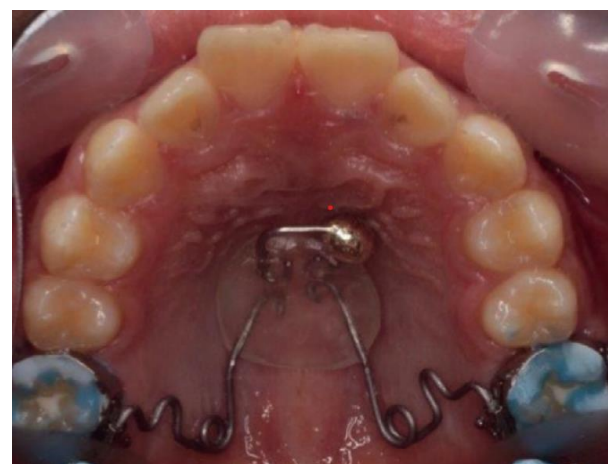


Fig 5 : Pendulum Appliance

(Image Courtesy : Hilgers JJ. The pendulum appliance for Class II non-compliance therapy. J Clin Orthod. 1992 Nov;26(11):706-14. PMID: 1298751.)

6) Distal Jet Appliance: Carano and Testa (1996) designed the Distal Jet appliance for both unilateral and bilateral Class II correction. This appliance features a bilateral piston and tube arrangement, with the tube embedded in an acrylic Nance button in the palate,



supported by attachments on the first or second premolars. A bayonet wire is inserted into the lingual sheath of each first molar band, with the free end acting like a piston within the tubes. Each tube is equipped with a nickel-titanium open-coil spring and an activation collar. Compressing the coil spring generates a distal force, which is maintained by retracting the activation collar and locking the mesial setscrew in place. The active components are positioned palatally, ensuring that the lines of force are close to the centre of resistance of the molars. NiTi coil springs are recommended to exert a force of 150 grams for children and 250 grams for adults. These springs are clamped on the tube to provide a distal force, resulting in bodily movement as the force passes near the centre of resistance. Reactivation involves sliding the clamp closer to the first molar once a month. After distalization is complete, the appliance can be converted to a Nance retainer or a passive Nance appliance. Typically, a movement of 2-3 mm is observed in 4 months.⁽¹³⁾



Fig 6 : Distal Jet Appliance

7) Band and U Loop Appliance: Band and U loop space regainer is a type of fixed unilateral expander. This appliance serves a dual purpose as both a space regainer and a space maintainer. Initially, it is activated to regain the lost space, and then it is kept passive as a space maintainer until the tooth erupts into the oral cavity. It is indicated for premature loss of a single tooth and space closure. This appliance is most effective when there is space present mesially to the erupting or erupted tooth, usually the first premolar, which can be moved into it. A suitable pre-formed stainless steel band is selected, or a molar band is constructed over the first permanent molar using stock band material with a diameter of 0.180x0.005 inches. After selecting or creating the band, an alginate impression of both arches is taken with the band in place.

The wire bending for the space regainer involves either a canine retractor or a "U" loop. The "U" loop appliance should be made of 21-gauge wire, whereas the canine retractor can be made with 22 or 23-gauge wire. If two "U" loops are used, one on the lingual side and one on the buccal side, the wire should be of 23-gauge. The position of the "U" loop or canine retractor should be slightly away from the band to avoid heating during soldering. The "U" loop or reverse canine retractor can be soldered on both sides of the tooth (buccal or lingual) depending on the available space and eruption pattern of the tooth. The spring or "U" loop should be properly covered (boxed) with plaster to prevent heating while soldering it to the band. Activating the appliance involves opening the "U" loop or the coil spring of the canine retractor. The advantages of this appliance are its simplicity and good patient compliance. After regaining the space, it can be kept passive as a space maintainer until the tooth erupts into the oral cavity. In cases of severe space loss, it can be used for mesial movement of the mesial tooth, followed by distal tooth movement of the permanent first molars with extra-oral headgear if needed. The limitations include that severe space loss with multiple impacted or unerupted teeth requires comprehensive analysis and fixed orthodontic treatment. If a permanent first molar needs to be distalized to regain lost space, extra-oral force with headgear may be considered.⁽¹⁴⁾



Fig 7 : Band and U Loop Appliance

8) Hotz Lingual Arch: In 1974, Hitchcock introduced a modified version of the lingual arch called the "Hotz lingual arch," which includes U loops for distal molar movement. The Hotz lingual arch is recommended in cases where the permanent tooth moves mesially, rather than the mesial teeth moving distally, and where there is sufficient space for the eruption of the permanent second



molar. The lingual arch provides compound anchorage from all the other teeth it touches. Additionally, a horizontal spur can be soldered perpendicular to the arch wire, contacting the distal surface of the premolar or canine, further enhancing the anchorage. The loop on the active side is adjusted periodically, typically once a month.



Fig 8 : Hotz Lingual Arch

9)Lip Bumper: A lip bumper appliance is employed in the mandibular arch to gain space or distalize molars, with its counterpart in the maxillary arch being the Denholtz appliance. It is utilized in the early mixed dentition stage for minimal molar distalization. Additionally, it is effective in uprighting mesially tipped molars to regain space within the arch. A lip bumper appliance is employed in the mandibular arch to gain space or distalize molars, with its counterpart in the maxillary arch being the Denholtz appliance. It is utilized in the early mixed dentition stage for minimal molar distalization. Additionally, it is effective in uprighting mesially tipped molars to regain space within the arch. Molar bands are placed on the permanent first molar, with molar tubes welded on the buccal side of each band. A labial arch wire is then engaged in both buccal tubes, and an acrylic sheath is prepared on the labial vestibule. This setup transfers forces from the lips directly to the buccal aspect of the first molar to distalize it. ⁽¹⁵⁾

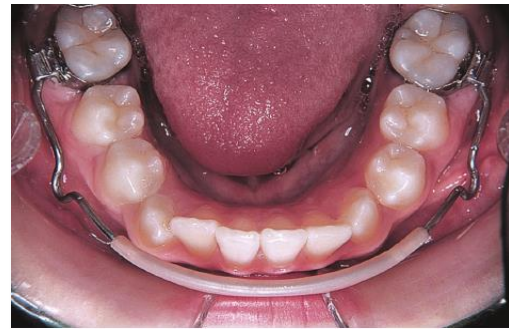


Fig 9 : Lip Bumper

(Image Courtesy : Nevant CT, et al. Lip bumper therapy. Am J Orthod Dentofac Orthop. 1991;100(4):330-6.)

10)Jackscrew Regainer: A mechanically driven appliance using a central jackscrew to produce outward pressure and regain space. It is suitable for regaining larger amounts of space, especially in cases of bilateral tooth migration into edentulous areas. The jackscrew is gradually activated to exert controlled force.



Fig 10 : Jackscrew Space Regainer

Removable Space Regainers

1)C-space Regainer: The C-space regainer is a removable appliance designed to achieve bodily molar movement without significant incisor flaring. It can be used to intrude teeth as well as move them distally or sagittally. This appliance is suitable for cases with mild arch length discrepancies treated by the extraction of second or third molars, and for open bite cases. The C-space regainer consists of a labial framework made from 0.036" stainless steel wire and an acrylic splint. A closed helix is incorporated into the framework in each canine region. The labial framework extends distally to lie as close to the buccal molar tubes as possible, allowing for easy insertion into the headgear tubes. The distal ends of the framework are polished down for a loose fit in the molar tubes. An 0.010" x 0.040" open coil spring is soldered distal to the helix, and 0.028" ball clasps are



used to retain the appliance. The working cast is placed on a large glass slab for the construction of the acrylic splint. Once the labial frame and ball clasps are stabilized, a separating medium is applied. The acrylic is typically applied to cover the crowns of all anterior teeth. The cast is immediately inverted on the glass slab, and the acrylic is extended labially according to the required anchorage. After the acrylic is cured, the plate is scalloped around the cervical margins, leaving it thick enough to contact the mandibular incisors. To avoid anterior protrusion, 0.028” ball clasps are added facially between the lateral incisors and canines to serve as hooks for Class II elastics or J hook headgear traction. Patients should be checked every three weeks to ensure the constant application of coil spring pressure. When reactivation is needed, the helix is squeezed with a heavy wire or three-prong plier, moving the labial wire extension and the coil spring distally. A molar overcorrection of at least 2mm distal to the normal Class I position is necessary due to mesial relapse.⁽¹⁶⁾



Fig 11 : C-space Regainer

(Image Courtesy : Chung KR, Park YG, Ko SJ. C-Space regainer. J Clin Orthod. 2000;34(1):32-39.)

2)Hawley Appliance with Helical Spring To move an upper 6-year molar distally with a Hawley appliance, a compressed helical spring is formed at a right angle to the alveolar ridge, adjacent to the mesial surface of the 6-year molar to be moved. This spring is designed to be adjustable, maintaining a distally directed pressure over a distance of 3 to 4 mm. A spring made of 0.028 yellow Elgiloy or 0.020 Australian wire achieves the desired movement when correctly positioned on the appliance and adjusted at two-week intervals. Hawley’s Appliance with Split Acrylic Dumb-bell Spring is utilized to regain up to 2 mm of lost space by distally tipping one of the permanent first molars. It is known for being an effective and comfortable appliance during treatment.⁽¹⁷⁾



Fig 12: Hawley’s Appliance with Split Acrylic Dumb-bell Spring

3)Split Acrylic Dumb-bell Spring: A variant of the Hawley appliance designed to distally tip the molar by 2 mm. It uses a split acrylic framework with embedded springs, providing gentle force for regaining space. It is comfortable and well-tolerated by patients.



Fig 13 : Split Acrylic Dumb-bell Spring

4)Fixed-removable Hawley Appliance: A hybrid appliance combining removable acrylic with fixed orthodontic bands on primary molars. Wire loops are soldered onto the bands and incorporated into the acrylic base, increasing retention and anchorage. It is especially useful in younger children with erupting permanent teeth.⁽¹⁷⁾

Comparison : Fixed vs Removable Space Regainers

Feature	Fixed Regainers	Removable Regainers
Patient Compliance	Not required	Highly dependent
Force Control	More precise and continuous	Less controlled; interrupted force
Usage Duration	Longer; remains in place	Limited by patient cooperation
Activation Frequency	Less frequent	Requires regular patient follow-up
Indications	Severe space loss; molar distalization	Mild-moderate space loss
Oral Hygiene	Harder to maintain	Easier to clean



Retention/Anchorage	Uses bands or soldered tubes	Depends on clasps and plate fit
Cost	Usually higher	Generally more affordable
Adjustment	Chairside or laboratory	Easily adjusted

Comparison: Fixed Space Regainers

Appliance	Design	Advantages	Limitations	Indications
Open Coil Space Regainer (OCSR)	U-loop with NiTi open coil spring and solder stops	Simple design, provides light continuous force	Causes uncontrolled tipping; limited axial control	Single-tooth space loss
Gerber Space Regainer	Prefabricated U-loop with coil spring and floss tie	Minimal chairside time; consistent force delivery	Lacks bodily control; limited range	Moderate space regaining
Double Banded Regainer	Bands on both adjacent teeth with soldered regaining unit	Reduces tipping; suitable for larger space	Technically complex; requires multiple bands	Moderate space loss
Gurin Lock Regainer	Sliding bar with NiTi spring and adjustable lock	Controlled movement; reciprocal force	May require additional anchorage	Unilateral molar distalization
Pendulum Appliance	Palatal acrylic with 0.6 mm SS springs and helices	Strong, consistent force; good molar control	Bulky; poor hygiene maintenance	Bilateral molar distalization
Distal Jet Appliance	Nance palatal button with piston-tube and NiTi spring	Provides bodily movement; convertible to Nance	Bulky; more expensive	Moderate-to-severe space loss
Band and U-Loop Appliance	Simple U-loop soldered on molar band	Easy to fabricate; dual-purpose (regainer + maintainer)	Only effective for minor cases; causes tipping	Mild-to-moderate space loss
Hotz Lingual Arch	Modified lingual arch with U-loops	Maintains arch length; bilateral effect	Less effective if teeth rotated or severely displaced	Early molar drift or mild loss

Lip Bumper	Acrylic shield with labial wire contacting molars	Uprights molars; improves arch length without tipping	Dependent on patient compliance	Mandibular minor space loss
Jackscrew Regainer	Bands with centrally placed jackscrew	Highly effective; controlled force for large spaces	Bulky; risk of overcorrection	Large bilateral space loss

Comparison : Removable Space Regainers

Appliance	Design	Advantages	Limitation	Indications
C-space Regainer	Labial wire, closed helix spring, acrylic splint	Produces bodily movement; minimal incisor flaring	Less retentive; limited anchorage	Mild arch length discrepancies
Hawley with Helical Spring	Hawley baseplate with adjustable helical molar spring	Easy to adjust; well-known fabrication method	Limited to minor space loss	Minor space regaining needs
Split Acrylic Dumbbell Spring	Split acrylic framework with embedded springs	Comfortable, gentle force	Limited range of action	Mild space loss with molar tipping
Fixed-removable Hawley	Hawley with fixed bands	Fixed retention	Harder to clean; bulky	Mixed dentition with erupting teeth

Clinical Decision Making

- **Severity of Space Loss:** Mild (Hawley) vs Moderate (Band & U loop) vs Severe (Jackscrew, Pendulum).
- **Arch Location:** Maxillary (Pendulum, Distal Jet) vs Mandibular (Lip bumper).
- **Age and Cooperation:** Younger or non-compliant patients benefit from fixed appliances.



- **Abutment Availability:** Affects the choice between removable vs fixed regainers.

Limitations of appliances

- Removable appliances depend on compliance.
- Fixed appliances may cause hygiene challenges and tipping.
- Severe space loss may require comprehensive orthodontics.
- Appliance failure or misfit may compromise results.

Future Considerations for regainers

- **Mini-screw anchorage** for enhanced stability in managing severe space loss.
- **3D-printed and CAD/CAM appliances** for better fit and patient acceptance.
- **Digital monitoring systems** to track force levels and treatment progress.

4. Conclusion

Space regaining is essential for intercepting malocclusion due to premature tooth loss. A wide array of fixed and removable regainers allows clinicians to select personalized treatment options. Understanding appliance biomechanics and patient-specific factors ensures optimal outcomes. Integrating digital and minimally invasive technologies will enhance future treatment paradigms.

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