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Space regainers –A review

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Abstract
Early loss of primary teeth lead to loss in space, arch length, arch perimeter and arch circumference. The normal occlusal relationship and normal permanent teeth alignment is not able to develop and permanent teeth remain impacted or erupt out of arch. When the space is progressively lost, the therapy should be considered to regain the space so that additional disharmonies do not develop. Space regainers are the appliances used to restore space and occlusal harmony and further minimize the complex orthodontic treatments and facilitate permanent tooth eruption. This article is an overview which depicts a range of space regaining appliances, removable and fixed, used to overcome or reduce space discrepancies.

Keywords: space regainers, space loss, interceptive orthodontics.

Introduction
The change from primary dentition to the permanent dentition is a complex phenomenon which includes the exfoliation of the primary teeth, the eruption of permanent teeth and the establishment of occlusion though independent yet harmonious sequence [1, 2]. There are many morphogenetic and environmental influences, which guide the occlusal development and a disorder or deviation in any of these elements may influence the occlusion. Among these elements, the primary teeth are of utmost importance since when there is physiologic exfoliation, there is also a favourable alveolar growth which often provide space for a better accommodation of the successor permanent teeth [1].

A pediatric dentist is often the first person to encounter the effects of premature loss of deciduous teeth. Thus, it is essential on the part of the pediatric dentist to take early measures in preventing the profound effects on future developing dentition, psychology and personality of child.

Space maintainers are appliances used to maintain space, so as to guide the un-erupted tooth into proper position in the arch. It not only maintains function and preserve arch length, but also maintain esthetics, prevent development of deleterious oral habits and eliminate any potential psychological damage a child could face. It also allows the permanent tooth to erupt unhindered into proper alignment and occlusion [3].

In 1998, Hoff ding and Kisling reported that premature loss of primary teeth caused space loss [3]. As a result of space loss, the permanent tooth may remain impacted, or it may erupt buccally or lingually [4].

Various appliances will help for both regaining the lost space as well as its maintenance for the eruption of the permanent tooth. At the initial appointment, the appliance is activated to regain the lost space and then it is kept passive till the tooth is erupted into the oral cavity. The dual function of the appliance will reduce the cost to the parents and saves time for both the dentist as well as for the patient [5].

Diagnosis
For any mesial or distal movement of teeth, diagnosis is of utmost importance. Radiographs and study models are used for assessing space required and alignment of the tooth in the arch. The tipping of teeth requires less force than the bodily movement of the tooth in the arch. So it is essential to diagnose whether teeth have moved bodily into the space or tipped axially. Another important point is the position of the erupting tooth distal to the tooth to be moved, i.e. permanent second molars as they have the potential to be impacted by the severe distalization of permanent first molar. Radiographs of the periapical structures are necessary [6].

Study models will provide details about rotation of the tooth, improper contacts and transverse relation of teeth. They also help in visualization of vertical, transverse and sagittal dental relationship that might hinder stability of Moyer's mixed dentition analysis and will be a good aid to determine measurement of space loss against an estimation of the space needed by the unerupted permanent tooth. Estimation based on radiographs demonstrates variance because of difficulties in standardized film placement, especially in the small mouth of the child with early mixed dentition [7].

For positioning the first permanent molars with use of an appliance, the reciprocal force which will be produced will get dissipated on the anterior teeth and surrounding supporting tissues which ultimately can lead to a detrimental movement of teeth anterior to the space loss e.g. flaring of the anterior teeth. This particularly occurs during the mixed dentition period when the permanent incisors are incompletely erupted and adversely influenced by even minimal forces. Furthermore, the forward movement of the unerupted, second permanent molar accompanies the forward movement of first molar, and any attempt to tip or reposition the first permanent molar may produce an impaction of the second molar [7]. Minimal space loss can be regained better. The space regaining procedure that involves tipping of first permanent molar can be accomplished more easily in the maxillary arch than in the mandibular arch. The procedure should be limited to those cases in which the occlusion is Class I, there is adequate anchorage, the second permanent molar is unerupted and there is favorable relationship of second permanent molar with the first permanent molar [7].

Distalization or bodily movement of molars can be most satisfactorily achieved by headgear appliance. In favorable situations, an effort should be made to regain space. Various removable and fixed appliances are used for space regaining in mixed dentition [8].

Coil springs

Stainless steel orthodontic coil springs provide sufficiently high applied forces to move a patient's teeth. However, they are unable to maintain a high applied force over a sufficient range of spring action. The force being applied by these springs typically diminishes very rapidly as the teeth start moving so they have to be replaced in order to obtain proper realignment of the teeth. Another disadvantage is that, stainless steel material quickly results in permanent deformation of the spring and they contain elements such as nickel, which have been known to cause adverse reactions in some patients [9].

The concept of NiTi coil springs was suggested in 1975 [10]. A NiTi orthodontic coil spring is made of alloy wire which exhibits shape memory thus allowing excellent super-elastic and spring-back properties. Also, coil spring can maintain a constant load value throughout a zone of deflection [11]. The open coil springs produce light, continuous forces through a long range of activation although the forces produced are slightly below the optimum 75-100 g range. NiTi coil springs deliver a constant force over a range of 7mm tooth movement with one activation. They can be used throughout the arch and require few activations, possibly only one to produce the desired tooth movement. 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 [12].

Removable Space Regainers

1. C-space regainer

C-space regainer is a removable appliance used to achieve bodily molar movement without significant incisor flaring. This appliance can be used to intrude teeth as well as to move them distally or sagitally, in cases with mild arch length discrepancy treated by extraction of second or third molars, and in open bite cases [13].

The C-space regainer consists of a labial framework, formed from 0.036" stainless steel wire and an acrylic splint. A closed helix is bent into the framework in each canine region. The labial framework is extended distally to lie as close to the buccal molar tubes as possible. This allows easy insertion into the headgear tubes. The distal ends of the framework should be polished down for a loose fit in 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 construction of the acrylic splint [13]. After the labial frame and ball clasps have been stabilized, a separating medium is applied. The acrylic is normally applied to cover the crowns of all anterior teeth. The cast is immediately inverted on glass slab and the acrylic is extended labially according to the amount of anchorage needed. After the acrylic is cured, the plate is scalloped around the cervical margins, leaving it thick enough to contact the mandibular incisors. In order 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 [13].

The patient should be checked every three weeks for the constant application of coil spring pressure. When re-activation is required, 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 will be needed because of the mesial relapse. A Nance button should be placed immediately after removal of C-space regainer to hold the molars in position. However, there is relatively insufficient literature on the use of C-Space regainer and recommendations on its removal and maintenance [13].

2. Upper 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 immediately adjacent to the mesial surface of the 6-year molar to be moved. The spring is arranged so that it can be adjusted to maintain a distally directed pressure over a distance of 3 to 4mm. A spring made of 0.028 yellow Elgiloy or 0.020 Australian wire produces the desired movement if it is positioned properly on the appliance and adjusted at intervals of 2 weeks [14].

3. Fixed-removable Hawley appliance

A more efficient upper Hawley appliance is fabricated by fitting two orthodontic bands to the primary first or second molars with 0.028 wire loops soldered on the lingual surfaces of the bands to incorporate the latter into acrylic appliance. This converts the removable Hawley appliance to a fixed-removable device, with improved anchorage capability and better retention stability during wear by the child. The single requirement is that there must be a primary molar tooth for banding, and the roots of which have not been resorbed enough to create excessive mobility, on each side of the arch [14].

4. Lower Hawley appliance with helical spring

The lower Hawley appliance have a labial bow with adjustment loops built into it labial to the cuspids. The wire passes distal to the cuspids over the ridge and is embedded in the body of the appliance on the lingual side of the alveolar ridge. This helps utilize the lower anterior teeth and so assists the whole lower arch in acting as a total anchorage unit. The wire for the labial bow is made of 0.025 or 0.028 yellow Elgiloy. The helical spring positioned against the mesial surface of the molar to be moved distally is made of either 0.028Elgiloy or 0.020 Australian wire. The helical spring for the lower Hawley appliance may be made in two configurations. The double helical spring requires slightly more time to bend but is compatible to the periodontium of the tooth being repositioned. These helical springs should be adjusted with little or no pressure exerted distally against the molar during the first week of treatment. At the second visit and thereafter at intervals of 2 weeks, the springs should be adjusted to produce a slight distal pressure against the 6-year molar. It takes 2 to 4 months to move a lower molar a distance of 2mm distally [14].

5. Lower Hawley appliance with split-acrylic spring

In the lower arch a Hawley appliance constructed with a split-acrylic dumbbell spring may be used to regain up to 2mm of lost space by tipping one of the 6-year molars distally. The dumbbell spring allows easy adjustment to add a distalizing force to the lower molar. The spring should be adjusted twice a month, creating an increment of opening in the split-acrylic area of about 0.5mm at a time. Any larger adjustment may not allow the appliance to be seated firmly into the area mesial to the molar being moved distally [14].

6. Lower Hawley appliance with sling-shot elastic

Instead of a specially contoured wire spring that transmits a force against the molar to be distalized, a wire elastic holder with hooks may be used. This is called a slingshot appliance, since the distalizing force is produced by the elastic stretched between the two hooks. One hook is located on the middle of the lingual surface of the molar to be moved. The other is arranged in the same position on the buccal surface of the molar. The child places a new elastic between the hooks while the appliance is outside the mouth. It is slipped into place, then the child's finger can guide the elastic into place smugly against the gingiva on the mesial margin of the molar to be distalized. The elastic can be changed once each day [14].

Goodale described three types of removable space regainers

7a. Free end loop spring space regainer

It utilizes a labial archwire which provides stability and retention, a back-action loop spring of no. 0.025 wire and an acrylic base of the appliance. At certain intervals of time, the free end of the loop is activated to achieve desirable movement of the tooth. A light force on the tooth to be moved is desired. The appliance should be checked and adjusted as often as necessary to maintain the light force on the molar. The type of loop spring wire can be changed to fit any situation, depending on the position of the tooth and the distance it needs to be moved. A free-end loop space regainer for the lower arch has a shorter wire loop, resulting in less distortion when the child inserts the appliance [5].

7b. Split-block space regainer

Split- block space regainer or split saddle space regainer differs from the free end spring type of space regainer. It consists of a dumbel constructed with a no. 0.025 wire which extend buccolingually and an acrylic block that is split buccolingually. The acrylic plate is split with the disk to form an activator portion, and the appliance is activated buccolingually periodically for tooth movement. The activator portion of the split block appliance is essentially the same as one that has been designed to establish a space for fixed bridge therapy. The unilateral type used for adults should not be used in the child's mouth, however because of the risks of loss of swallowing [8].

7c. Fixed loop-spring space regainer

It differs from other types only in the design of the spring activation. This appliance resists breakage and provides a satisfactory method of moving the molar distally. The mesial portion of the spring loop is embedded in the resin and passed out through the edentulous space. This portion of the wire should contact the distal surface of the tooth which is mesial to the space. This prevents distal movement of this tooth. A loop is then formed, and the wire returned back to contact the mesial surface of the first permanent molar. At this end, the wire is bent around a stable embedded in the resin. The spring loop should be allowed to move freshly on the staple. Retention of this appliance is gained by the use of wire clasps. Orthodontic wire of no. 0.025 or no. 0.030 dimension is embedded in the acrylic resin, brought through the embrasure and then bent down to contact the teeth below the contact points. After the desired movement of the permanent molar has been attained, the appliance may be used as a space maintainer by soldering the activator portion of the spring to the guide wire in its passive position, or by filling in the edentulous region with additional resin [8].

8. Sling shot space regainer

Sling shot space regainer distalizes molar with a wire elastic holder with hooks as an alternative to spring which transmits a force against the tooth to be distalized. It is termed as sling shot appliance, as the forces to distalize tooth were produced by the elastic which was stretched on the middle of the lingual and the buccal surface of the molar to be moved. The child places new elastic between the hooks while the appliance is outside the mouth. It is slipped into place then the child's fingers can guide the elastic into proper position. If the appliance is of a removable type, periodic checking should be done to evaluate whether the patient is using it or not, whether there is any distortion or breakage of the appliance or irritation of soft tissues. If the teeth are emerging underneath the appliance, the portion of the acrylic is cut off to give way for the teeth to erupt into position. In case of fixed appliances, check for any breakage of the appliance at the soldered joints or band material. It is also checked that whether the appliance is loose due to dissolution of cement which may result in food lodgement and caries. The appliance is removed every 6 months or 1-year depending on the situation and the abutment tooth is checked for any caries or decalcification. Polishing of the abutment is done followed by fluoride application. Then the appliance is recemented in position. Regular radiographic examination of developing permanent teeth is also necessary. The appliance can be removed or discarded soon after the succedaneous teeth erupted into proper position in the oral cavity [5].

Fixed Space Regainers

1. Jaffe appliance

An appliance for certain minor tooth movements was described by Jaffe (1963), is useful when the presence of ankylosed tooth, early loss of a deciduous molar or an extraction result in filling of adjacent segments into proximal dental area. Movement is obtained by the use of light spring pressure against a sliding section or arch. The appliance consists of buccal and lingual arms of molar bands and the sliding arch to move the desired tooth or teeth [5].

2. Gerber space maintainer

It is the type of appliance which may be fabricated chair side with relatively short duration of the appointment as it does not require tedious laboratory procedures. A band is prepared for the abutment tooth and fitted, and the mesial surface is marked for placement of "U" loop, which may be stabilized by welding or soldering. The wire "U" assembly is placed in the molar tube, and the appliance is allowed to contact the tooth mesial to the edentulous space. Expanded center and lower left views show occlusal rest added to the wire section to reduce cantilever effect. An eyelet may be welded to a flattened part of the tube. Next to the band weldable tube stops are soldered on wire portion (lower right) and open coil spring sections are cut to fit over the wire between "stops" and ends of "U" tube. The length of open coil spring is measured by establishing the assembly in desired position and the distance between mesial contact or solder point to the entry of wire in the tube and add the amount of space required or regained, plus additional 1-2 mm to ensure activation of spring. Load springs, tie floss or steel ligature through eyelet and over "U" wire to hold stored force in compressed spring. Compress springs so that the assembly should fit in the edentulous space and cement the assembly in place. After cementation, cut the ligature and remove to activate regainer [5, 8].

3. Hotz lingual arch

Another method for moving molars distally utilizes the looped Hotz lingual (Hitchcock 1974). Hotz lingual arch is indicated in situations where the permanent tooth moves mesially rather than distal movement of mesial teeth and also in cases where sufficient space is present for eruption of permanent second molar. The lingual arch provides compound anchorage from all the other teeth which the lingual arch touches. A horizontal spur can be soldered perpendicular to the arch wire contacting the distal surface of the premolar or canine. This compounds the anchorage additionally. The loop on the active side is adjusted periodically once a month. After adjustment, the wire is forced forward and then slipped downward into appropriate space [8].

4. Lip bumper appliance

Lip bumper appliance is used in the mandibular arch for gaining space or for distalization of molar and its counterpart in the maxillary arch is Denholtz appliance. Molar bands are prepared on permanent first molar and molar tubes are welded on the buccal side of each molar band. Labial archwire is then engaged in both the buccal tube and acrylic button is prepared on the labial vestibule. It transfers forces from lips directly on to the buccal aspect of first molar to distalize the molar. It is used in early primary dentition for minimum distalization of molar. Also useful in uprighting the mesially tipped molars to regain space in the arch [8].

5. King appliance

King (1977) described an appliance for regaining of space in both maxillary and mandibular arch. The anchorage unit for the mandibular arch is basically a fixed lingual arch with bands fitted on the first deciduous molar of the treatment side and the first permanent molar on the opposite side. Then an edgewise bracket is spot-welded to the buccal surface of the primary molar band, and the completed anchorage unit is cemented in place. A band with an angulated buccal tube is cemented on the malpositioned molar, and a straight section of wire with an open coil spring is introduced into the buccal tube and ligated into the bracket. The anchorage unit must be modified for the treatment in the maxillary arch. A millimeter a month is satisfactory progress in the repositioning of first molar. When a Class I or cusp to cusp molar relation is achieved, a conventional space maintaining appliance should be given [5].

6. Anterior space regainer

Two 0.018 × 0.025 standard labial tubes are adapted into the mouth. A stainless steel mesh is spot welded and trimmed to the tubes. The enamel of the labial surfaces of left central and right lateral incisors is etched with 35% phosphoric acid, and each labial tube is individually bonded to each abutment tooth. When the composite is polymerized, a piece of 0.014" standard round wire is introduced into the lateral incisor tube. The wire is then inserted in a 0.036" × 0.009" open coil spring previously selected and passed through the labial tube of the central incisor. A distal bend is made 2 mm from the distal ends of the tube. After 3 weeks, the coil spring is activated, and after the space is slightly over widened, 0.016" round wire is inserted with the same coil spring. Three weeks later the wire is changed to a 0.018" and finally to a 0.018" × 0.025" wire, leaving the coil spring only for retention. After that, an acrylic pontic is fixed over the wire and coil spring, using the same type of composite already in the patient's mouth [5].

7. Sliding loop regainer

The sliding loop space regainer is recommended in cases where space loss occurs due to premature loss of mandibular second primary molar, when both the first molar and first premolar have tipped into the available space. The setup applies a constant force to move the first premolar mesially and, with some reciprocal distal movement, move the permanent molar distally.[15] It is designed with one band on the permanent molar and two 0.036 inch buccal tubes are welded to the molar band. A loop, similar to the band and loop is fabricated using a 0.036inch stainless steel wire. An open coil spring of approximately 2mm in excess of the space to be regained is cut and inserted into the prepared loop. The loop and coil spring component is placed and the loop is slided into the buccal tubes. An occlusal stop is soldered to the loop component of the appliance, and placed in contact with the occlusal surface of the premolar to prevent rotation of the tooth. No further adjustment is usually necessary [16].

8. Open coiled space regainer

Open coiled space regainer (OCSR) is a reciprocal active space regainer. The Fabrication of OSCR is same as sliding loop regainer. However, in the "U" loop of the appliance enough solder is flown to make a stop at the junction of the straight part & curved part of the wire, both buccally & lingually in contrast to the occlusal stop in the sliding loop appliance to prevent 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 [16].

9. Double banded space regainer

In this appliance, both the teeth adjacent to edentulous area are banded so that the possibility of tipping is avoided as compared to when only one tooth is banded. Chalakka P *et al*. (2012) reported the use of "Double banded space regainer" in maxillary arch as early exfoliation of left second primary molar had resulted in mesial migration of the permanent left first molar resulting in 3.5 mm of space between it and the primary left first molar. Space regainers were fabricated for both the arches. In maxillary arch, after 6 months, the space gained was 5.1 mm with the use of "Double banded space regainer" and in mandibular arch, after 5 months, the space gained mesial to the first-left premolar was 4 mm, improving the canine space to 7 mm [17].

10. Gurin lock space regainer

Gurin lock space regainer is a unilateral fixed space regainer. It is indicated when mesial movement of bicuspid is required without distal movement of the other teeth. It consists of bands on the first premolar and molar and 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 affected by the proximity of the adjacent teeth. In order to restrict the movement of one of the abutment teeth, it is necessary to add additional anchorage. This is done by using a jackscrew with labial/lingual arch wires. Activating the Gurin Lock is accomplished with a special box wrench [15].

11. Pendulum appliance

The pendulum appliance may be used for unilateral or bilateral distalization of maxillary first molar teeth when mesial drift of upper first molars is present due to early loss of primary molars. It can also be used in non-extraction treatment of mild to moderate crowding [18].

The pendulum appliance contains an acrylic plate that is retained in place either by clasps to the first premolars or the acrylic is integrated with a metal frame that is soldered to bands on the first premolars. Distalization arms or springs are constructed from 0.6 mm stainless steel round-wire that consists of a closed helix and a U-loop. The purpose of the closed helix is to allow for activation of the distalization arms. The U-loops are incorporated mesial to the molars to allow for adjustment of the axial inclination during distalization. This wire is soldered to molar bands. Typically, an initial activation of 60° to 70° (around the width of one molar) will generate 250g of force per side. The appliance is activated extra-orally and is cemented in place. The appliance is monitored at monthly intervals where it is removed for reactivation and re-cementation is done with luting GIC [19].

The advantage of this appliance is that it is less dependent on patient compliance. It is easy to fabricate and allows correction of minor transverse and vertical molar positions by adjustment of the springs. The appliance is well accepted by the patients [20].

The pendulum appliance as reported by Hilgers in 1992 can lead to a favorable mesio-buccal rotation as well as bodily movement of the first molars with the incorporation of a U-loop in the spring. This could be of use to improve the Class I molar relationship and to yield additional space. [16] Hilgers (1992) proposed variation in design of pendulum appliance including a lingual sheath on the molar bands allowing intra-oral adjustment of the springs, a Nance holding arch or utility arch wires inserted for stabilization while allowing the premolars to drift distally and an expansion screw incorporating in the Nance button allowing space gaining and arch coordination [19].

Nappee MM *et al*. (2014), presented a new Pendulum variant using a mini-screw, the "Pendulis". It follows the original concept (titanium-molybdenum alloy distalization springs and polymethyl-methacrylate pellet) but dental support is replaced by a single palatal mini-screw (median in adults, para-median in children) to which the device is fixed by means of a metal welded cap which can be easily positioned and removed by the practitioner. This appliance allows for better control of the oral hygiene and completely controlled extra-oral activation [23].

12. Distal jet appliance

Carano and Testa (1996), designed an appliance that can be used for either unilateral or bilateral Class II correction. The Distal Jet consists of 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 and the free end is inserted into the tubes, much like a piston. A nickel-titanium open-coil spring and an activation collar are placed around each tube. Compressing the coil spring generates a distally directed force. The activation collar is retracted and the mesial setscrew in each collar is locked onto the tube to maintain the force. The active components have to be placed palatally. Ideally, they result in lines of force running close to the center of resistance of the molars [22].

NiTi coil springs exerting a force of 150 grams for children and 250 grams for adults is recommended. The springs are clamped on the tube to exert a distal force, bodily movement is achieved as the force passes close to the center of resistance. Reactivation is done by sliding the clamp closer to first molar once a month. Once distalization is completed the appliance can be converted to a Nance retainer or passive Nance appliance. Movement of 2-3mm is seen in 4 months [22].

13. Band and U loop space regainer

Band and U loop regainer is type of fixed unilateral expander. This appliance can serve dual purposes of space regainer and space maintainer at the same time. Initially, the appliance is activated for regaining the lost space and then it is kept passive as a space maintainer in the same place till the tooth is erupted into the oral cavity. It is indicated in premature loss of single tooth and space closure. This appliance is most effective when there is space present mesially to the erupting or erupted tooth (usually first premolar) which can be moved into it [23].

A suitable pre-formed stainless steel band is selected or a molar band is constructed over the first permanent molar with stock band material of 0.180x0.005inch diameter. After the band is made or selected, an alginate impression of the both arches are taken keeping the band in place. The wire bending for the space regainer comprises of either a canine retractor or a „U" loop. The „U" loop appliance should be made of 21 gauge of wire, whereas the canine retractor can be made with 22 or 23 gauge of wire. When we give two „U" loops, one on lingual side and the other one on the buccal side, the wire

should be of 23 gauge. The position of the 'U' loop or the canine retractor should be placed a little away from the band to avoid heating while soldering the appliance. The „U" loop or reverse canine retractor can be soldered on both side of the tooth (buccal or lingual side) depending on space available and eruption pattern of the tooth (for example, the canine retractor can be soldered with a lingual arch space maintainer). The spring or the „U" loop should be covered properly (boxing) with plaster to prevent heating while soldering the spring with the band. The activation of the appliance comprises of opening the „U" loop or the coil spring of the canine retractor [23].

The advantages of this appliance are that it is simple and the patient compliance is good. After regaining the space, it can be kept passive as a space maintainer till the tooth is erupted into the oral cavity. When severe space loss has been taken place, it can be used for mesial movement of the mesial tooth followed by distal tooth movement of the permanent first molars with extra- oral head gear if required [23]. The limitations are severe space loss with multiple impacted or unerupted teeth require comprehensive analysis and fixed orthodontic treatment. If a permanent first molar is to be distalized to regain lost space, extra-oral force with headgear may be considered [23].

14. NiTi bonded space regainer

NiTi bonded space regainer was introduced by K.S Negi in 2007. It is a simple appliance which can be used chair-side in a single visit. A composite dimple is bonded on the buccal side of permanent first molar and with the help of an explorer burrow a tunnel into the mesial of dimple, creating a composite tunnel that is open only on the mesial end. A piece of 0.016 inch NiTi wire is then bonded on the buccal side of primary molar/first premolar and extended beyond the dimple. After the composite sets on both the teeth with the help of birdbeak plier, the free end of wire is directed into the tunnel made in the dimple of first molar. This will give a form of activated loop of NiTi wire. A small amount of bonding material is placed in the opening of the tunnel to make the attachment more permanent. Over time, loop returns to its original shape due to unique shape memory property of NiTi wire, distalizing and up-righting the first molar. Once the active correction is completed, the wire segment is left in place as a passive space maintainer till the eruption of second premolar [24].

The whole procedure can be completed in a single visit. There is no need of procedures like impression making, fitting of bands and soldering. Better oral hygiene can be maintained as appliance is self-cleansing. There is also improved patient compliance [25].

Maintenance and Recall

If the appliance is of a removable type, periodic checking should be done to evaluate whether the patient is using it or not, whether there is any distortion or breakage of the appliance or irritation of soft tissues. If the teeth are emerging underneath the appliance, the portion of the acrylic is cut off to give way for the teeth to erupt into position.

In case of fixed appliances, the appliance is checked for any breakage at the soldered joints or band material. It is also checked that whether the appliance is loose due to dissolution of cement which may result in food lodgement and caries. The appliance is removed every 6 months or 1-year depending on the situation and the abutment tooth is checked for any caries or decalcification. Polishing of the abutment is done followed by fluoride application. Then the appliance is re-cemented in position. Regular radiographic examination of developing permanent teeth is also necessary. The appliance can be removed or discarded soon after the succedaneous teeth erupted into proper position in the oral cavity [5].

Conclusion

Management of space problems in the mixed dentition plays an important role in pediatric dental practice. An understanding of the development in the primary and mixed dentitions can help in deciding when and how to intercept the malocclusion due to premature loss of deciduous teeth.

Proximal stripping and serial extraction are irreversible and invasive techniques for treating a malocclusion while space regaining with removable and fixed space regainer appliances are noninvasive techniques and helps in interception of malocclusion.

References

1. Kumari BP, Kumari NR. Loss of space and changes in the dental arch after premature loss of the lower primary molar: A longitudinal study. J Indian Soc Pedod Prev Dent. 2006; 24:90-6.
2. Moyers RE. Ortodontia. 4th ed. Cuanabara Koogan: Rio de Janeiro, 1991, 107-8.
3. Bijoor RR, Kohli K. Contemporary space maintenance for the pediatric patient. The New York State Dent J., 2005; 71(2):32-35.
4. Kisling E, Hoff ding J. Premature loss of primary teeth: Part 111, drift ing patterns for diff erent types of teeth aft er loss of adjoining teeth. J Dent Child. 1979; 46:34-8.
5. Muthu. Paediatric dentistry: principles and practice. 2nd Edition, 2011; Elsevier:360-364.
6. Proffi TW. Contemprorary Orthodontics. 2nd Edition, Mosby Year Book, 380-383.
7. Bishara Textbook of Orthodontics. 2nd Edition, Elsevier, 410-412.
8. Gawrishankar. Textbook of Orthodontics. 1st Edition, Jaypee Brothers, 470- 500
9. Farzin-Nia F, Sachdeva RC, inventors; Ormco Corporation, assignee. Orthodontic coil springs and methods. United States patent US. 1995; 5:429-501.
10. Civjan S, Huget EF, DeSimon LB. Potential applications of certain nickel-titanium alloys. J Dent Res. 1975; 54:89-96.
11. Miura F. Inventor; Gac International, Inc., assignee. Orthodontic coil spring. United States patent US, 1991; 5:046-948.
12. Von Fraunhofer JA, Bonds PW, Johnson BE. Force generation by orthodontic coil springs. The Angle Orthodontist, 1993; 63(2):145-8.
13. Chung KR, Park YG, Ko SJ. C-Space regainer for molar distalization. J Clin Orthod. 2000; 34(1):32-39.
14. Sim JM. Minor tooth movements in children. Mosby Company. Second edition.
15. Aliakbar Bahreman, Early-Age Orthodontic Treatment. First edition, chapter, 4, 73- 104. Quintessence books.
16. Da Costa GC, Chalakkal P, Aras MA, Chitre V. Use of the Open Coil Space Regainer for Tooth Movement Prior to Prosthodontic Treatment. Journal of clinical and diagnostic research: JCDR. 2015; 9(6):ZJ03.
17. 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(2):161.

18. Cetlin NM, Ten Hoeve A. Nonextraction treatment. J Clin Orthod. 1983; 17:396-413.
19. Hilgers JJ. The pendulum appliance for Class II non-compliance therapy. J Clin Orthod. 1992; 26:706-714.
20. Wong AM, Rabie AB, Hägg U. The use of pendulum appliance in the treatment of Class II malocclusion. British dental journal. 1999; 187(7):367-70.
21. Nappee MM, Nappee FJ, Kerbrat JB, Goudot P. The Pendulis appliance: a palatal miniscrew supported molar distalization device. Orthod Fr. 2014; 85(3):265- 73.
22. Carano A, Testa M. The distal Jet for upper molar distalization. J Clin Orthod. 1996; 30:374-380.
23. Kirtaniya BC, Singla A, Gupta KK, Khanna A, Kaur G. Space Regainer Cum Space Maintainer-A New Appliance For Paediatric Dentistry. Indian J Dental Sciences. 2014, 6(3).
24. Negi KS. Modified bonded space Regainer/Retainer. Orthod Cyber J., 2007.
25. Negi KS. NiTi bonded space regainer/maintainer. Journal of Indian Society of Pedodontics and Preventive Dentistry. 2010; 28(2):113.