

Space Management in Paediatric Dentistry

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Introduction

There are many morphogenetic and environmental influences, which effects the occlusal development and a disorder or deviation in any of these elements may influence the occlusion. The permanent teeth dislocation occurs in the eruptive, pre functional and functional periods of the eruption, i.e. within the primary arch and in the mixed dentition stage.¹ Loss of arch-length has been related mainly with tooth migration following premature loss of primary teeth. It is considered one of the most frequent aetiology for space loss in children. Loss of arch-length results in a loss of structural balance and functional efficiency.² Space management includes space maintenance, space regaining, space supervision and serial extraction. This article provides a summary of the various methods of space management during the mixed dentition period.

1. SPACE MAINTENANCE –

Space maintenance can be defined as the preservation of space left by primary incisors, primary canines, primary molars and

A B S T R A C T

Management of space problems associated with the transitional stages from primary to permanent dentition is a routine component of Pedodontic practice and a complex phenomenon with a variety of physiological adaptations of occlusion. Problems in the dental arches involve lack of space, space loss, maleruption, malposition, and mal-alignment of teeth. All such problems relate to the following modes of treatment: space maintenance, space gaining and guidance in alignment and occlusion. Dental arch-length is the most important of the dental arch dimensions in the developing individual. The maintenance of arch-length during the primary, mixed and early permanent dentition is of great significance for the normal development of a functional well-aligned and balanced occlusion. Loss of arch-length has been related mainly with tooth migration following premature loss of primary teeth. It is considered one of the most frequent etiological causes for space loss in children. Appropriate space maintainers should be provided for prematurely lost primary molars. This article provides a summary of the various methods of space management during the mixed dentition period.

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sometimes the primate spaces.^{3,4} Premature loss of primary maxillary first molars has been associated with a number of consequences such as tipping of the first permanent molar.⁵ The early loss of primary molar teeth can eventually cause narrowing in the dental arch and mesialisation of permanent molars resulting in crowding of teeth in the dental arch.⁶ About 51% of the prematurely lost first primary molars and 70% of prematurely lost second primary molars result in a loss of space and a consequent malposition of a permanent tooth in that quadrant.⁷ Space maintainers are fixed or removable appliances used to preserve arch length following the premature loss or elective extraction of a tooth/teeth.⁸ The Purpose of providing a space maintainer⁹ includes 1) preserving arch length following the premature loss of a primary tooth/teeth, 2) allows the permanent tooth to erupt unhindered into proper alignment and occlusion. Influencing factors when space maintenance is considered are a) Time elapsed since tooth loss¹⁰, b) Dental age of the patient¹⁰, c) Amount of bone covering the unerupted tooth¹⁰, d) Available space¹¹, e) Timing of emergence of permanent teeth¹², f) Inter-digitation¹³, g) Oral musculature and Habits¹³. The Royal College of Surgeons of England guidelines on the early loss of primary teeth states that the main indications for space maintainers are in the event of early loss of⁸: 1) Primary second molars and 2) Primary first molars where crowding is severe. Space maintainers can be categorised according to their

respective segments of placements and further into removable or fixed types.

Space Maintenance in Anterior Segment

1) Removable partial denture -This can be given for young children who show a degree of co-operation and interest. It is not advisable to give a removable space maintainer in children with uncontrolled dental caries or who cannot maintain a proper oral hygiene to reduce the caries activity.³

2) Fixed Appliances - If a fixed appliance is required, one approach is to attach the anterior replacement teeth to a 0.040 or 0.045 inch stainless steel wire frame work retained with bands or crowns on the second primary molar. Chang, Chen and Chang reported an appliance to replace prematurely lost maxillary anterior teeth using a double stainless steel crown on abutment teeth and artificial teeth made from a donor cast.^{14,15}

*Groper Appliance*¹⁶ - This appliance is similar to Nance holding arch, but with acrylic teeth processed to the wire instead of a palatal acrylic button in the rugae area. The round wire should be 0.036 to 0.040 inch in diameter and is attached to either the first or second primary molars with either SS crowns or SS bands. The acrylic teeth are attached to metal cleats that have been soldered to the palatal wire bar. The teeth sit directly on the alveolar crest without any gingival colored acrylic extending into the vestibule or on to the palate.

Space Maintenance in Buccal Segment

1) Removable appliances - Acrylic partial denture is indicated when there has been bilateral loss of more than a single tooth.⁹

2) Fixed Space Maintainers -

Band and loop appliances - It is usually used for preserving space created by premature loss of single primary molar.¹³ It consists of a band cemented commonly to the tooth posterior to the edentulous space and a loop of wire across the edentulous space abutting the anterior tooth.¹⁷ The loop should be fabricated wide enough so that the succedaneous tooth can erupt into it.¹⁸ The crown and loop is a variation of the band and loop appliance, and is used where stainless steel crown therapy is necessary on the abutment teeth.⁸ Another approach to the crown and loop appliance is to place a band and loop appliance over the crown. If difficulty is experienced when fitting a band over the crown, the next largest size crown can be modified by cutting out the occlusal surface and using it as a band.¹³

*Mayne Space Maintainer*¹⁹ - Designed by W R Mayne, is a type of non-functional space maintainer. Gellin in 1990 described a technique where banding the first primary molar for guidance, which can be used in cases where the second molar is lost before the eruption of the first permanent molar.³ Direct Bonding Applied to Space Maintenance²⁰ is a new type of unilateral space maintainer, utilizing the technique of acid conditioning and subsequent direct bonding has been designed.

*Intra-alveolar appliance*²¹ - It was introduced by Gerber and extended by Croll. The fixed distal shoe space maintainer was first proposed by Willets (1932). Nowadays the commonly used one is that described by Roche (1942), a crown or band and bar appliance. Free-end Space Maintainer²² is a removable space maintainer that is open on one end and can be employed to guide the first permanent molar.

Band and Bar - This is a fixed functional type of space maintainer in which the abutment teeth on either side of the extraction space are banded and connected to each other by a bar.¹⁹ Broken Stress Functional Space Maintainer¹⁹ prevents intolerable loads from being thrust on the supporting teeth.

*Glass Fiber-reinforced Composite Resin*²⁴ - These Fixed Space Maintainers²⁴ are made with EverStick which is a semi-manufactured product made of glass fibers, thermoplastic polymer, and light-curing resin matrix for reinforcing the dental polymer.

Fixed lingual arch - It is a bilateral fixed space maintainer, popularised by Burstone, consisting of a single heavy-gauge stainless steel wire adapted anteriorly to the lingual aspect of mandibular arch and posteriorly attached to the bands on the first permanent molars.⁸ The lingual arch appliances were effective in maintaining arch length throughout the transition from the mixed to the permanent dentition.²³ Active lingual arch have 2 inches adjustment loops incorporated into the original design by Holtz. and can also be used for

regaining space.³ Semifixed lingual arch¹⁹ has precision made vertical posts soldered at right angles to distal extensions which fit precision made tubes on the lingual surfaces of the molar bands and are held together by means of lock wire. It is mainly used for active movement when tipping of the molar is less than 5 degrees as it allows for an easy removal and adjustment.¹⁹

*Nance palatal arch appliance*⁸ - This is a maxillary custom-made fixed appliance developed by H.N. Nance in 1947, consisting of a heavy gauge stainless steel wire soldered to the palatal aspect of the first permanent molar bands. The wire is directed from the molars anteriorly and is attached to an acrylic button, about 0.5 inches in diameter.¹³

*Transpalatal arch*⁸- Originally described by Robert Goshgarian in 1972, the transpalatal arch is a maxillary fixed appliance consisting of a heavy gauge stainless steel wire that extends from one maxillary first permanent molar, along the contour of the palate, to the contralateral first molar. It is adapted to the curvature of the palatal vault, so that it lies 2-3 mm away from the palatal mucosa, and an omega loop is usually incorporated midway across the span. The original design included a straight bar extending across the palate. It is referred as transpalatal bar.²⁴ Maximum pressure was obtained when the loop of the Transpalatal arch (TPA) was placed at the middle of the palatal mucous membrane between the right and left second molars.²⁵

2. SPACE REGAINING -

Absence of proximal contact is the most significant environmental factor associated with mesial permanent molar migration. Mesial drift constitutes tipping and/or bodily movement directly related to the extent of first permanent molar eruption at the time space was created.²⁶The age range between seven and ten years proves to be best for tipping or bodily moving six year molars distally to recover lost arch space.²⁷ Early loss of second primary molars with subsequent loss of space continues to be the most difficult problem to manage.²⁸Under usual circumstances, the distalization potential for maxillary molars is 5-7 mm per side, while mandibular molar distal movement is limited to 1 or 2 mm per side.²⁶The space regainers are appliances that are used for recovering the space which once existed in the arch.²⁹ Space regaining can be accomplished by using either intraoral appliance or extra oral appliances.

(A) Intra Oral Appliances

1) Removable Space Regainers

Appliances with helical coils or loops - These appliances can provide light continuous forces. This is achieved by a spring using 0.7 mm wire. A double helical loop is usually required when rotation is combined with tipping. A single helical loop is usually sufficient when only tipping is needed.²⁸ The compressed helical spring is formed at a right angle to the alveolar ridge immediately adjacent to the mesial surface of the tooth 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 4 mm. The appliance is adjusted at intervals of 2 weeks.²⁷

Split Saddle type or split acrylic dumbbell spring - This is most successful for regaining 1 or 2mm space without alteration of distal portion of the appliance. It is indicated only when a small amount of space needs to regain.²⁸The spring should be adjusted twice a month, creating an increment of opening in the split acrylic area of about 0.5 mm at a time.²⁷

Screw type space regainer - A removable appliance with a jackscrew offers the best control of any removable appliance when correction of rotation is not needed or can be treated as a separate step. It is instructed to open the jack screw one quarter turn twice a day until the appliance is difficult to seat. At that time, the instructions given are to one quarter turn every second or third day.²⁸

Sling shot type - This appliance offers durability and light continuous forces. The appliance has the advantage of allowing rotational forces to occur during distalization by the tipping forces.²⁸ This is called a slingshot appliance, since the distalizing force is produced by the elastic stretched between the two hooks. The child places new elastic between the hooks while the appliance is outside the mouth. It is slipped into place; then the child fingers can guide the elastic into place snugly against the gingival on the mesial margin of the molar to be distalized. The elastic can be changed once each day.²⁷

*Removable molar distilizer*³⁰ - Removable molar distilizer (RMD) is a segmented removable appliance which includes two parallel arches between the segments, and exerts a continuous force to the maxillary molars via compressing Ni – Ti open coil springs placed over the arches.

2) Fixed Space Regainers -

Lower lingual arch space regainer - If the choice is fixed appliance therapy, the force is best directed distally against a lower first molar by means of a lower lingual arch with two U-loops. As the U-loop is opened up slightly at each 2-week interval, the anchorage resistance of the remainder of the teeth to the movement permits the molar in question to be moved slowly in a distal direction. A treatment time of 3 to 6 months should be planned to accomplish 2 mm of distal movement in one quadrant.²⁷

Fixed Appliance with Open Coil Springs - A fixed intraoral appliance with open coil springs activation has been used successfully to move maxillary or mandibular molars distally for space regaining. As the space opens, replace the wire and spring with longer sections at approximately 2 week intervals until the desired position is attained³¹

Gerber Space maintainer - This type of appliance is fabricated directly in the mouth. It has a “U” assembly which is soldered or welded in place and fitted into tube. The appliance placed and wire section extended to contact the tooth mesial to the edentulous area.³

(B) Extra Oral Appliances²⁷

High pull headgear- The force is exerted from above the occlusal plane and thus has both distalizing and intrusive effects. It is used in all cases in which vertical control of the molars is important.

Low pull headgear- The force is exerted from below the occlusal plane and has extrusive as well as distalizing effects.

3. SPACE SUPERVISION –

It is the term applied when it is doubtful according to the mixed dentition analysis, whether there will be room for all teeth. The main strategy falling under this category is the management of space through the timely extraction of teeth, based on the assessment of the condition of root formation of the succedaneous teeth. This type of treatment of sound primary teeth is called timed extraction.²⁹

4. SERIAL EXTRACTION –

Serial extraction is a series of related and correlated steps taken in an attempt to intercept a developing malocclusion in the mixed dentition.²¹ Mayne³² points out that serial extraction should be limited largely to those cases that have good faces, those that present harmony and balance of two tissue systems, bone and muscle, and varying degrees of harmony in the tooth size. Proffit(1986) cites a predicted tooth size/arch size discrepancy of 10 mm or greater as an indication for serial extraction, whereas Ringenberg(1964) cited a discrepancy of 7mm or greater.³³ Several sequences of treatment have been advocated

with the most common one being those of Dewel, Tweeds and Nance. The sequence proposed by Dewel is extraction of CD4. Tweeds proposed the extraction sequence as DC4. Nance method is similar to Tweeds and involves the extraction of deciduous first molar followed by the extraction of first premolars and the deciduous canines.³² Members of the Tweed foundations conducted several studies on the difference between successful and unsuccessful treatment. The six measurements that are crucial in the evaluation³⁴ are 1) Frankfurt mandibular plane angle (FMA), 2) ANB angle, 3) Z angle, 4) Occlusal plane, 5) SNB angle, 6) Posterior facial height/anterior facial height ratio.

Conclusion – Dental neglect of the primary dentition is the principal cause of malocclusion in the permanent dentition. Early, regular, and satisfactory dental care maintains the primary teeth in a healthy condition until their normal exfoliation. Dental restorations in the primary dentition, particularly the molars involving the proximal surfaces, should be restored to their full mesio-distal diameter for the prevention of space loss and the maintenance of arch length. The objective of space maintenance and tooth guidance should be kept constantly in mind, that is, to prevent something bad from getting worse. Problems in the dental arches involve lack of space, space loss, malposition and malalignment of teeth. All such problems relate to the following modes of treatment: space maintenance, space gaining, and guidance in alignment and occlusion.

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