



## Space maintainers: A review

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### Abstract

To keep a child's mouth in optimum health and usefulness is the duty and responsibility of every dentist. In the quest for providing optimal dental care, the age – old maxim of 'prevention is better than cure' holds true. In this endeavor the pedodontist is most evenly poised to carry the mantle of providing the required services. One of the most important services is that of maintaining arch length prior to the eruption of the permanent teeth. It should be the goal of every practitioner providing oral health care for children and adolescents to assess and guide the developing occlusion toward optimum outcomes. Hence the present article reviews in general regarding the space maintainer.

**Keywords:** usefulness, Responsibility, practitioner, maintainer

### Introduction

Dental caries is one of the most common diseases in children and numerous teeth have to be extracted every year due to extensive decay. Thus, there is no question of the importance of preventing and treating dental decay and providing the children with a comfortable functional occlusion of the deciduous teeth. When restorative treatment is not feasible & tooth has to be extracted, the practitioner should keep in mind the risk of losing space and the consequent malocclusion<sup>[1]</sup>.

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One of the most important services is that of maintaining arch length prior to the eruption of the permanent teeth<sup>[2]</sup>. It should be the goal of every practitioner providing oral health care for children and adolescents to assess and guide the developing occlusion toward optimum outcomes.

The clinical guideline of the American Academy of Pediatric Dentistry illustrates this responsibility with the following statement<sup>[3]</sup>:

Guidance of eruption and development of the primary, mixed, and permanent dentitions is an integral component of comprehensive oral health care for all pediatric dental patients. Such guidance should contribute to the development of a permanent dentition that is in a stable, functional, and esthetically acceptable occlusion. Early diagnosis and successful treatment of developing malocclusions can have both short-term and long-term benefits while achieving the goals of occlusal harmony and function and dentofacial esthetics<sup>[4]</sup>. The present article provides a review on space maintainers.

### Effects of premature loss of deciduous teeth

Premature loss of a deciduous tooth or a group of teeth may

lead to the following wide range of implications<sup>[5]</sup>

1. Space loss – The premature loss the deciduous tooth will lead to the imbalance of forces maintaining the tooth in the mouth, leading to an uncontrolled force causing space loss.
2. Speech – Specially, primary anterior teeth have a role to play in the development of speech articulation in children. Premature loss may lead to abnormal tongue position as well.
3. Esthetics – A child may feel ashamed to smile or laugh with his peers because of embarrassment.
4. Psychological effect – The child may sometimes have a more withdrawn attitude due to the unesthetic appearance.
5. Mastication – It may lead to loss of masticatory efficiency and hence improper assimilation of food. Thus, general health gets affected.
6. Growth stimulation – the development of dentofacial structures will be absent.

The dentition is designed to function as a single unit retained spatially by the sum of forces exerted upon each individual member. Three distinct forces, i.e. occlusal, muscular and eruptive forces contribute to space closure. The effect on each segment of the arch is different<sup>[6]</sup>.

### Objectives of space maintenance

The goal of space maintenance is to prevent loss of arch length, width, and perimeter by maintaining the relative position of the existing dentition<sup>[7]</sup>.

1. Preservation of primate space.
2. Preservation of the integrity of the dental arches.
3. Preservation of normal occlusal planes.
4. In case of anterior space maintenance, it should aid in esthetics and phonetics.

### Space maintainers

Space maintainers can be defined as appliances used to

maintain space or regain minor amounts of space lost, so as to guide the unerupted tooth into a proper position in the arch.

Ideal requirements <sup>[8]</sup> Certain prerequisites for all space maintainers whether they are fixed or removable are-

1. They should maintain the mesiodistal dimension of the lost tooth.
2. If possible, they should be functional, atleast to the extent of preventing the overeruption of the opposing tooth or teeth
3. They should be simple and strong as possible.
4. They must not endanger the remaining teeth by imposing excessive stresses on them.
5. They must be easily cleaned, and not serve as traps for debris which might enhance dental caries and soft tissue pathology.
6. Their construction must be such that they do not restrict normal growth and developmental processes or interfere with such functions as mastication, speech or deglutition.

### Classification of Space Maintainers

#### 1. According to Raymond C. Thurrow

- a. Removable
  1. Lingual arch
  2. Extraoral Anchorage
- c. Individual tooth space maintainer

#### 2. According to heinrichsen

- a. Fixed space maintainers
  - Class I
    1. Nonfunctional
    1. Bar type – no longer in use
    2. Loop type

#### 2. Functional Type

1. Pontic type
2. Lingual arch type
  - Class II – Cantilever type – Distal shoe, Band and loop

#### 3. According to Hitchcock

- a. Removable, fixed or semi-fixed
- b. With bands or Without bands
- c. Functional or nonfunctional
- d. Active or passive
- e. Certain combinations of the above

#### 4. According to Shobha Tandon

- a. Removable
  1. Cast partial or Wrought metal
  2. Passive or Active
  3. Functional or nonfunctional
- b. Fixed
  1. Banded or Bonded
  2. Passive or active
  3. Functional or nonfunctional

### Fixed space maintainers

Fixed space maintainers are the appliances, which are fixed onto the teeth and utilize bands or crowns for their construction.

### Advantages of fixed space maintainers <sup>[9]</sup>

1. Bands and crowns are used which require minimal or no preparation.
2. They do not interfere with passive eruption of abutment teeth.
3. Jaw growth is not hampered
4. The succedaneous permanent teeth are free to erupt into the oral cavity
5. They can be used in un-cooperative patients.
6. Masticatory function is restored, if pontics are placed.

### Disadvantages of Fixed space maintainers <sup>[9]</sup>

1. Elaborate instrumentation with expert skill is needed.
2. They may result in decalcification of tooth material under the bands.
3. Supra-eruption of opposing tooth can take place if pontics are not used.
4. If pontics are used it,
  1. Can interfere with vertical eruption of the abutment tooth.
  2. May prevent eruption of replacing permanent teeth if the patient fails to report.

### Common fixed space maintainers include

- Band and loop
- Crown and loop
- Lingual arch
- Palatal arches, which include-
  - Nance palatal holding arch
  - Transpalatal arch
- Fixed appliances for anterior space maintenance

### Modifications

1. Occlusal stops – A band and loop may require a vertical projection in which the loop contacts the abutment tooth. This occlusal rest can prevent tipping and can prevent the anterior portion of the loop from sliding below the proximal height of contour, which can lead to the wire's embedding in the gingival tissue several weeks or months later. Disadvantage of the occlusal rest added to the loop is that it could interfere with the occlusal migration. It could hinder the continuing eruptive process in the immature dentition <sup>[7]</sup>.
2. Meyne's space maintainer – It uses single-wire extension "arm" rather than a full loop from the posterior abutment to contact the anterior abutment. The single arm of 0.036 or 0.040 wire is rigid enough to hold the space. It reduces half possible interferences to eruption of underlying tooth <sup>[2]</sup>.
3. Band and Bar– Both teeth on either side of the space are banded and a bar is soldered between them <sup>[10]</sup>.
4. Reverse band and loop – This appliance has been used in cases where the second primary molar is lost and permanent molars have not erupted fully to support a band (Gorlin 1990). In such cases primary first molar is banded and a loop is made that touches just below the marginal ridge of permanent molars <sup>[5]</sup>.
5. Crown and loop – It uses stainless steel crown as the abutment base and offers the advantage of increase stability and retention <sup>[2]</sup>.

### Stainless Steel Crowns

Stainless steel crowns in the construction of space maintainers were discussed by Pruhs, R.J. in 1978 <sup>[11]</sup>.

Preformed stainless steel crowns may also be used to advantage in the design and construction of space maintainers. They have several advantages over the use of bands.

1. Decalcification and recurrent caries do not occur, because the clinical crown of the tooth is covered.
2. They provide better retention, when they are crimped to engage cervical undercuts.
3. It is easier to keep the cementing agent dry during cementation, thereby insuring a proper set.
4. It is not necessary to remove and re-cement them during regular recall visits.

Stainless steel crowns require tooth preparation, when used on primary molars. However, when used on permanent tooth for the construction of a lingual arch, the abutment teeth should not be prepared. This results in a slightly opened bite, which closes in a very short time. When stainless steel crowns are used in the construction of a lingual arch, it is important to inform the parent that the teeth beneath the crowns are healthy and that the crowns will be removed when space maintenance is no longer necessary. Stainless steel crowns are indicated for space maintainers, it is intended that the appliance be used for more than two years. Teeth banded for longer period of time are more subject to decalcification and decay than teeth covered with stainless steel crowns. When a primary molar is selected as an abutment, and the tooth requires a restoration, it should be crowned and the maintainer wire soldered to the crown. This is preferable to restoring the tooth with another material such as amalgam, and then using a band for the space maintainer.

### Lingual Arch Space Maintainer

It is the most effective appliance of space maintenance and minor tooth movement in lower arch. It is a bilateral, non-functional, passive/active, mandibular fixed appliance [4]. Lingual arches are commonly used in the primary and mixed dentitions where there has been premature loss of multiple posterior primary teeth [12]. The mandibular lingual arch is also a very useful auxiliary appliance for early treatment in the mandibular arch and for critical anchorage cases treated with fixed appliances [13]. In preventive and interceptive orthodontics, the use of a lower lingual arch is a widely accepted procedure.

### Removable Lingual Arch

The removable arch wire has precision-made vertical posts soldered at right angles to the distal extensions, which fit precision-made tubes on the lingual surfaces of the molar bands and are held in position by means of lock wire attached to the distal extensions turned forward to engage either under the tube or to latches on the surface of the tubes.

### Transpalatal Arch

It is a Unilateral, non-functional, passive, maxillary fixed appliance that has been recommended for stabilizing the maxillary first permanent molars when primary molars require extraction. (6) Transpalatal Arch (TPA) originally described by Robert Goshgarian in 1972, the Transpalatal arch is a maxillary fixed or removable appliance consisting of a heavy gauge [0.036 inch (0.9 mm) or higher] stainless steel wire that extends from one maxillary first permanent

molar, along the contour of the palate, to the contralateral first molar [12].

The rigid transverse wire prevents the two main space loss patterns of upper first permanent molars: mesiobuccal rotation and anterior bodily displacement. While the appliance may allow some minor mesial tipping of the upper molars, this is generally considered insignificant as to overall space loss in the maxillary arch [2].

### Anterior Space Maintenance

To maintain a smooth conversion of infant's jaws to the adult form, nature has given two series of dentition. If there is any deviation, then jaw form and overall facial profile along with the psychology of an individual may be altered. Early loss of maxillary incisors due to caries is very common in young children and before two-third of roots of permanent incisors are formed. So, the space should be maintained functionally as well as aesthetically by a suitable space maintainer depending on the dental age of the patient. The space maintainer may be of removable, fixed or semi-fixed, functional or nonfunctional type [14]. An anterior appliance incorporating artificial primary teeth may be considered to satisfy esthetic and functional needs. Acrylic partial dentures have been successful in the replacement of single and multiple maxillary primary incisors. Given the demands of cooperation in wear and frequent appliance loss or damage, such removable appliances can be problematic in preschool-age children [2].

### Glass Fiber Reinforced Composite Resin Space Maintainers

Many different space maintainer types are available today. Above mentioned fixed stainless-steel space maintainers have following disadvantages:

1. Disintegration of the cement
2. Failure to prevent rotation and tipping movement of abutment teeth
3. Being embedded in gingival tissues
4. Caries formation
5. Needing preparation of the abutment teeth.
6. Require long laboratory stages
7. Involve the process of soldering during the preparation
8. Can lead to ruptures in the soldered sites over time;
9. Can require solders that have cytotoxicity<sup>15</sup>.

These disadvantages reveal the need for designing new type of space maintainers. With the advances in technology, attempts have been made to utilize newer materials in the fabrication of space maintainers. One such material is glass fiber-reinforced composite resin. Although fiber-reinforced composite resins have been developed for dental use, their application in pediatric dental practice is still limited<sup>16</sup>. Recently, fiber-reinforced composites (FRC) have been introduced and used in<sup>17</sup>:

1. Immobilization of periodontally involved teeth
2. Creation of a fixed partial denture with a composite resin pontic or a natural tooth pontic
3. Stabilization of traumatized teeth
4. Orthodontic fixed space maintainers
5. Reinforcement of temporary crowns and bridgework
6. Denture repairs.
7. Two commercially available fiber systems are
8. Polyethylene fiber (Ribbond, Seattle, Wash)
9. Glass fiber (everStick, Stick Tech Ltd, Turku, Finland)

### Periodontal Conditions Associated with Space Maintainers

Local factors play an important role in plaque retention and development of gingivitis. It has been reported that fixed and removable orthodontic appliances, brackets and bands frequently cause gingival infection thereby complicate oral hygiene and cause inflammation, bleeding, gingival enlargement and increase in pocket depth<sup>[18]</sup>.

The main reasons are the increase in plaque accumulation caused by bands, brackets and arch wires which are more likely to be in contact with the gingival margin and mechanical or chemical irritation due to exposed cement. Also cleaning the teeth by toothbrush and dental floss is more difficult<sup>[19]</sup>. However, it was also reported that orthodontic appliances don't necessarily cause irreversible alveolar bone tissue destruction<sup>[20]</sup>.

### Role of Pedodontist

A pedodontist is often the first person to encounter the effects of premature loss of deciduous teeth. Thus, it is essential on the part of the pedodontist to take early measures in preventing the profound effects on future developing dentition, psychology and personality of the child. The following timely measures should be instituted.

- a. Parent Education– Pedodontists are largely responsible for the prevention in orthodontics. They first see the child patient. This provides the best opportunity to educate the parents to the realization that deciduous teeth are fully as important as the permanent ones and, in some respects, even more so. An investment in their early care will be of immediate benefit to the child as well as be of priceless value later.
- b. Caries control – Dental caries of the deciduous teeth, when neglected or when not given proper dental care, is the principal cause of malocclusion of the permanent dentition. Thus, all measures that play a role in caries prevention play a major, albeit indirect role in preventive orthodontics.
- c. Maintenance of tooth shedding time table – A difference of more than 3 months in shedding and eruption in one quadrant, compared to others, should be viewed with suspicion and investigated thoroughly.
- d. Maintenance of dental arch integrity – Preventive orthodontics to a large extent is responsible for the maintenance of arch integrity, most commonly following the premature loss of a deciduous tooth.
- e. Other measures – Many other factors like care of the deciduous teeth, maintenance of occlusal equilibrium if there is any functional reason, extraction of supernumerary tooth, ankylosed tooth, monitoring of incipient malocclusion are important part in pediatric dental practice apart from space management.

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