Space maintenance can be defined as the provision of an appliance (active or passive) which is concerned only with the control of space loss without taking into consideration measures to supervise the development of dentition.
Space maintainers are 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

- It should maintain the entire mesio-distal space created by a lost tooth.
- It must restore the function as far as possible & prevent over-eruption of opposing teeth.
- It should be simple in construction.
- It should be strong enough to withstand the functional forces.
- It should not exert excessive stress on adjoining teeth.
- It must permit maintenance of oral hygiene.
- It must not restrict normal growth & development and natural adjustments which take place during the transition from deciduous to permanent dentition.
- It should not come in the way of other functions.
CLASSIFICATION OF SPACE MAINTAINERS

1) Acc. To Hitchcock-
   - Removable or fixed or semi-fixed.
   - With bands or without bands.
   - Functional or non-functional.
   - Active or passive.
   - Certain combinations of the above.
2) Acc. To Raymond C. Thurow-

- Removable
- Complete arch
  - Lingual arch
  - Extra-oral anchorage
- Individual tooth
3) Acc. To Hinrichsen-

**Fixed space maintainers-**

**CLASS I**

(a) Non-functional types-
   i. Bar type.
   ii. Loop type.

(b) Functional types-
   i. Pontic type.
   ii. Lingual arch type.

**CLASS II**

Cantilever type (distal shoe, band & loop.)

**Removable space maintainers-**

Acrylic partial dentures
PLANNING FOR SPACE MAINTENANCE

The following considerations are important to the dentist when space maintenance is considered after the untimely loss of primary teeth:

a) *Time elapsed since loss* -

If space closure occurs, it usually takes place during the first 6 months after the extraction. When a primary tooth is removed & all factors indicate the need for space maintenance, it is best to insert an appliance as soon as possible after the extraction. Often the best approach, if possible, is to fabricate an appliance before the extraction & deliver it at the extraction appointment.
b) **Dental age of the patient**

The chronologic age of the patient is not so important as the developmental age. Gron studied the emergence of permanent teeth based on the amount of root development, as viewed on radiographs, at the time of emergence. She found that teeth erupt when three-fourths of the root is developed, regardless of the child's chronologic age.
c) **Amount of bone covering the unerupted tooth** - if there is bone covering the crowns, it can be readily predicted that eruption will not occur for many months; a space-maintaining appliance is indicated.

d) **Sequence of eruption of teeth** - the dentist should observe the relationship of developing & erupting teeth adjacent to the space created by the untimely loss of a tooth.
e) Delayed eruption of the permanent tooth—

in case of impacted permanent tooth, it is necessary to extract the primary tooth, construct a space maintainer & allow the permanent tooth to erupt at its normal position.

If the permanent teeth in the same area of the opposing dentition have erupted, it is advisable to incorporate an occlusal stop in the appliance to prevent supraeruption in the opposing arch.
f) **Congenital absence of the permanent tooth**

If permanent teeth are congenitally absent, the dentist must decide whether it is wise to hold the space for many years until a fixed replacement can be provided or it is better to allow the space to close.

If the decision is made to allow the space to close, there will rarely if ever be bodily movement of the teeth adjacent to the space. Therefore, orthodontic treatment will be needed to guide the teeth into a desirable position.
g) **Presentation of problems to parents**—
take sufficient time to explain existing conditions & discuss the possibility of the development of a future malocclusion if steps are not taken to maintain the space or to guide the development of the occlusion. Also explain that the space-maintaining appliance will not correct an existing malocclusion but will only prevent an undesirable condition from becoming worse or more complicated.
APPLIANCE THERAPY

**Fixed space maintainers**-
- Band & loop space maintainer.
- Crown & loop appliance.
- Lingual arch.
- Palatal arch appliance.
- Transpalatal arch.
- Distal shoe.
- Esthetic anterior space maintainer.
- Band & Bar type space maintainer.

**Removable space maintainers**-
- Acrylic partial dentures.
- Full or complete dentures.
- Removable distal shoe space maintainer.
Four appliances generally used to maintain space in the primary dentition are:

- The Band & Loop
- The Lingual Arch
- The Distal Shoe
- The Removable Appliance
Fixed Space Maintainers

Space maintainers which are fixed or fitted onto the teeth are called fixed space maintainers.

**ADVANTAGES:**

1. Bands and crowns are used which require minimum or no tooth 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-co-operative patients.
6. Masticatory functions is restored if pontics are placed.
DISADVANTAGES:

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 teeth can take place if pontics are not used.
4. If pontics are used it can interfere with vertical eruption of the abutment tooth & may prevent eruption of replacing permanent teeth if patient fails to report.
CONSTRUCTION-

The fixed space maintainer generally are constituted of the following components-

a) Band
b) Loop / arch wire
c) Solder joint
d) Auxiliaries
The band forms an important part of the constructions of the various fixed appliances several bands are employed such as-

1) Loop bands
2) Tailored bands
3) Preformed seamless bands made of precious metal or chrome alloy.
Every band should possess a few ideal criteria such that:

- It should fit the contours of the tooth as closely as possible, thereby enhancing the placement of the attachment in relationship to the tooth.
- Should not extend subgingivally any more than necessary.
- Band material should resist deformation under stresses in the mouth.
- Resist tarnish.
- Inherent springiness.
- Cause no occlusal interference.
STEPS IN BAND FORMATION

A) Separation of teeth
   By (i) Brass wire
   (ii) Elastic threads

B) Band formation
   By (i) Direct formation
      - Band pinching
      - Festooning
      - Trimming
      - Folded flap
   (ii) Preformed bands
   (iii) Indirect band technique

C) Welding
D) Soldering
Fig. 9.15 Band showing the festooning
WELDING -

- It is the process during which a portion of the metal being joined is melted & flowed together.
- Bands are generally joined by welding.
Fig. 9.12 Welded band material with eyelet
SOLDERING-

It is the process by which the two metals are joined together by an intermediary metal of a lower fusion temperature. The most common solder used is the silver solder containing silver, zinc, copper & tin.
The appliance is typically used when more than one tooth has been lost in a quadrant. It is often the only alternative because there are no suitable abutment teeth and because the cantilever design of the distal shoe or the band and loop is too weak to withstand occlusal forces over a two-tooth span.

Not only can the partial denture replace more than one tooth, it also can replace occlusal function.

Two drawbacks of the appliance are retention and compliance.
Fig. 9.21a Functional removable space maintainer - upper arch

Fig. 9.21b Functional removable space maintainer lower arch
Figs 21-42a and b  Use of a removable space maintainer to replace a primary mandibular second molar.
Advantages:

1. Easy to clean and permit maintenance of proper oral hygiene.
2. Maintain or restore the vertical dimension.
3. Can be worn part time allowing circulation of the blood to the soft tissues.
4. Room can be made for permanent teeth to erupt without changing the appliance.
5. Stimulate eruption of permanent teeth.
6. Help in preventing development of tongue thrust habit into the extraction space.
DISADVANTAGES:

1. May be lost or broken by the patient.
2. Un-co-operative patients may not wear the appliance.
3. Lateral jaw growth may be restricted, if clasps are incorporated.
4. May cause irritation of the underlying soft tissues.
**Indication:**

1. When aesthetics is of importance.
2. In case the abutment teeth cannot support a fixed appliance.
3. In cleft palate patients who require obturation of the palatal defect.
4. In case the radiograph reveals that the unerupted permanent tooth is not going to erupt in less than five months time.
5. If the permanent teeth have not fully erupted it may be difficult to adapt bands.
6. Multiple loss of deciduous teeth which may require functional replacement in the form of either partial or complete dentures.
CONTRAINDICATIONS-

1. Lack of patient co-operation.
2. Patients who are allergic to acrylic material.
3. Epileptic patients.
BAND & LOOP APPLIANCE
(Fixed, Non functional, Passive space maintainer)

- It is used to maintain the space of a single tooth.
- Inexpensive & easy to fabricate.
- It does not restore the occlusal function of the missing tooth.
Fig. 9.16 Space maintained for missing primary first molars using the crown and loop on left side, band and loop on the right.
Indications

- Unilateral loss of the primary first molar before or after eruption of the permanent first molar.
- Bilateral loss of a primary molar before the eruption of the permanent incisors.
Fig 21-8  The tooth has been cut off the cast. Note the sticky wax around the band.

Fig 21-10  The finished loops should end in the middle third of the band.
Fig 21-10  The finished loops should end in the middle third of the band.

Fig 21-11  Completed wire, bent before soldering.
Fig 21-35  Cut the cast to accommodate the bending of the bar.

Fig 21-36  Bar material in place ready to bend.
LINGUAL ARCH
(Fixed, Non functional, Passive Mandibular arch appliance)

- Used to maintain the posterior space in the primary dentition.
- The lingual arch is often suggested when teeth are lost in both quadrants of the same arch.
- Belong to those group of space control appliances which not only control anteroposterior movements but also are capable of controlling & preventing an arch perimeter distortion, by controlling the lingual collapse of single tooth or segments of the arch.
It consist of a round stainless steel or precious alloy wire, 0.32 to 0.40 inches in diameter closely adapted to the lingual surfaces of the teeth & anchored to bands on the first permanent molars.

The means used to anchor the archwire to the bands will define whether the lingual arch is of a removable or fixed type.

Because the permanent incisor tooth buds develop & erupt somewhat lingual to their primary precursors, a conventional mandibular lingual arch is not recommended in the primary dentition (bilateral band & loop appliances are recommended in this situation.)
Fig. 9.17a Pre-formed lingual arches

Fig. 9.17b Fixed lingual arch space maintainer with banded first first permanent molars
PASSIVATION

The lingual archwire should be completely passive. This is done by heating the wire to a dull brownish appearance, while keeping the wire gently in place on the cingula with an old instrument.
Fig. 9.17c Lingual arch with 'U'-loop

Fig. 9.17d Modified lingual arch
The maxillary lingual arch is feasible in the primary dentition because it can be constructed to rest away from the incisors.

Two types of lingual arch designs are used to maintain maxillary space—
- the Nance arch.
- the Transpalatal arches.

These appliances use a large wire (36 mil) to connect the banded primary teeth on both sides of the arch that are distal to the extraction site.

The difference b/w the two appliances amounts to where the wire is placed in the palate. The Nance arch incorporates an acrylic button that rests directly on the palatal rugae. The Transpalatal arch (TPA) is made from a wire that traverses the palate directly without touching it.
NANCE ARCH or NANCE SPACE HOLDING APPLIANCE
(Fixed, Non-functional, Passive, Maxillary arch appliance)

Nance (1947) described the “preventive lingual wire”.

It consists of bands on the upper molars, with the arch wire extending forward into the vault.
CONSTRUCTION-

- The acrylic button is present on the slope of the palate & provides an excellent resistance against forward movement (U loop). The wire should extend from the lingual of bands to the deepest & most anterior point in the middle of hard palate.

- 'U' bend is given in the wire for the retention of the acrylic 1-2mm away from the soft tissue.
TRANSPALATAL ARCH
(Fixed, Non-functional, Passive appliance)

• The arch is soldered to both sides, straight without a button & without touching the palate.
• The basis of the appliance is that the migration & rotation is caused by rotation around the lingual root. By preventing this, space loss is prevented by the appliance.
• Cross arch anchorage can be used if only one of the primary molars is lost & both the permanent molars are erupted.
Fig 21-16  Transpalatal bar from one permanent first molar across the palate to the opposite permanent first molar.
DISTAL SHOE (Intra-alveolar, Eruption guidance appliance)

- Used to maintain the space of a primary second molar that has been lost before the eruption of the permanent first molar.

- An unerupted permanent first molar drifts mesially within the alveolar bone if the primary second molar is lost prematurely. The result of the mesial drifts is loss of arch length & possible impaction of the second premolar.
Fig 21-37  Completed distal shoe after the bar material has been soldered to the stainless steel crown.

Fig 21-38  Polished appliance.
Fig 21-39  Intra-alveolar appliance in place.

Fig 21-41a  Distal shoes were placed when the patient was 4 years old.
After 1 year, the distal shoes were replaced with crown and loops.
21-41c  Final permanent dentition.
DISADVANTAGES-

- Because of its cantilever design & the fact it is anchored on the occlusally convergent crown of the primary first molar, the appliance can replace only a single tooth & is somewhat fragile.
- No occlusal function is restored because of this lack of strength.
- Histologic examination shows that complete epithelialization does not occur after placement of the appliance.
REFERENCES

• Dentistry for the child and adolescent; Ralph E. McDonald; David R. Avery; eight edition 2004; C.V. Mosby Company.
• Paediatric Dentistry; Richard R. Welbury; Second edition 2001; Oxford Medical publications.
• Graber T.M.; Orthodontics principle and practice; third edition; page no. 315 to 317
• William R. Proffit; Contemporary Orthodontics; second edition; page no 127
• Gurkreet Singh; Text book of Orthodontics; first edition; 2004; Published by Jitendra P. Vij; page no. 539 to 547