

Recent Advances In Fixed Space Maintainers

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Abstract

Proper space management in children is essential for the growth and development of the dental arches. Premature loss of a tooth or tooth structure, may result in a loss of arch circumference, crowding and/or malocclusion due to shifting of adjacent teeth. A fixed space management is used to prevent the loss of arch length, arch width, or arch perimeter. Main considerations of a space maintenance are based on time of tooth loss, dental age, bone coverage, sequence of eruption, delayed eruption of permanent teeth, available space and congenital absence of permanent teeth. A thorough understanding of the recent developments in fixed space maintainers and their different types can help in deciding when and how to maintain space and prevent malocclusion in primary and

mixed dentition. There are several newer fixed space maintainers which help the pediatric dentist to effectively choose the appropriate appliance for the betterment of their child patient.

Keyword : Cise space maintainer, Groper appliance, , H-appliance, metal free space maintainer, NIMS modification, Zach-Risson-type,

Introduction

The primary dentition plays a very important role in the child’s growth and development ^[1]. Proper space management in children is essential for the growth and development of the dental arches ^[2]. Davenport described the concept of space loss due to premature loss of primary teeth in 1887. In 1971, Love and Adams reported a greater proportional space loss resulting from mesial migration of

the posterior teeth^[3]. In 1961 Breakspear reported that D loss in the maxillary or mandibular arches resulted in arch length reduction of 0.8 mm and 0.7 mm, respectively. When E loss occurred, the space loss was 2.2 mm in the maxilla and 1.7 mm in the mandible^[4]. Laing et al (2009) reported the premature loss of a tooth or tooth structure, if not compensated, may result in a loss of arch circumference, crowding and/or malocclusion due to shifting and/or drifting of adjacent teeth^[5].

Fixed space maintainers have been used since the beginning of the 20th century in the fields of orthodontics and pediatric dentistry^[6]. JC Brauer in 1941 defined space maintenance as the process of maintaining a space in a dental arch previously occupied by a tooth or a group of teeth^[7]. American Academy of Pediatric Dentistry (AAPD) states that the objectives of space management are to prevent the loss of arch length, arch width, or arch perimeter by maintaining the relative position of the existing dentition^[8]. The main considerations for space maintenance are based on time of tooth loss, dental age, bone coverage, sequence of eruption, delayed eruption of permanent teeth, available space and congenital absence of permanent teeth^[9]. A thorough understanding of the recent developments in fixed space maintainer's and their different types can help in deciding when and how to maintain space and prevent malocclusion in primary and mixed dentition.

Fixed space maintainers

Definition----According to medical dictionary fixed Space maintainer is a temporary orthodontic appliance used following the early loss or extraction of a tooth (as a milk tooth) to prevent the shifting of adjacent teeth into the resulting space. Several investigators have brought out several types of fixed space maintainers(SM) to maintain the space effectively in the dental arch. This article attempts to review all the newer fixed space

maintainers in recent literature to help the pediatric dentist to effectively choose the appropriate appliance for the betterment of their child patient.

Recent advances:

Three-dimensional (3D) printing band and loop : It is a process of making 3D solid objects from a digital file. The 3D digital model is saved in (STL) format and sent to the 3D printer where the layer by layer design of an entire 3D object is formed. Prepared cast is scanned using a 3D digital dental scanner followed by the designing of the band and loop similar to the conventional space maintainer. SMs are printed: (i) using a titanium-based powdered metal material and (ii) using a clear photopolymer resin^[10]. (Fig.1)

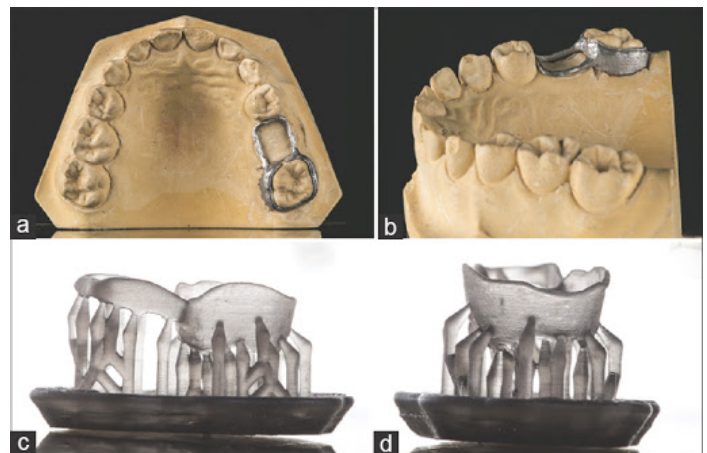


Fig: 1: a and b) Metallic three-dimensional-printed space maintainer of titanium-based powdered metal material and (c and d) using a clear photopolymer resin

Band and loop with NIMS modification---- In cases with long standing loss of upper first primary molar, mesio-buccal cusp and mesial marginal ridge of opposing side of first primary molar almost touch the ridge in the edentulous space. To prevent interference with occlusion one of the arms of the conventional band and loop has to be removed to create space and allow proper occlusion^[11]. (Fig.2)



Fig. 2: NIMS modification

Space Maintainers Combined with Open-Face Stainless Steel Crowns

--- A window is created on the vestibular surface of the stainless steel crown and is cemented to the abutment teeth. The borders of the window are to be 1-1.5 mm from the mesial and distal contact surfaces and 1 mm from the gingival to the occlusal surface. Impressions are taken and the space maintainer is prepared. Abutment teeth are etched and polymerized with visible light for 10 seconds. 0.53 mm x 0.64 mm long-space maintainer made of orthodontic rectangular wire is placed first on the mesial abutment tooth and fixed with Tetric Flow and then on the distal abutment tooth where the window has been cut and is fixed using the resin^[12]. (Fig. 3).

Use: To compensate for the cementation failure of conventional crown and loop



Fig. 3: Open faced stainless steel crown

Modified Nance Palatal arch for missing anterior teeth

---- This can be used if anterior tooth is avulsed along with any posterior primary teeth in the same arch. Patient's natural teeth can be used as pontics for the anterior region. Traditional Nance appliance is prepared, acrylic button is incorporated at the junction of the two wires embedding the wires from the pontics. The whole assembly can be stabilized in their final position on posterior teeth using luting cements^[13]. (Fig. 4.)



Fig. 4 : Modified Nance Palatal arch

Zach-Risson-type transpalatal bar(ZTPB)---- ZTPBs is a handmade appliance with Blue Elgiloy wire and have 3 loops. For an improved engagement and for the lingual

attachments of the bands ends of the bar are longer than the standard transpalatal arch. Prefabricated or custom made bands are selected for the abutment teeth and the wire is soldered on their lingual aspect. The whole assembly is cemented to the upper molars with luting cement.(Fig. 5)

Uses; upper molar derotation, expansion of the upper arch, maintaining arch widths, supporting anchorage, improving vertical control^[14].



Fig. 5: Zach-Risson-type transpalatal bar

Groper appliance --- To serve as replacements for the missing incisors prosthetic primary teeth can be affixed to a lingual arch or a palatal arch extending from banded molars. This is a Groper appliance. Acrylic or composite teeth are processed and attached to the wire with composite resin and the assembly is attached to either the first or second primary molars with either SS crowns or bands ^[15].(Fig. 6)

Uses: provide esthetic solution, help in masticatory function and speech development, and deleterious tongue habits can be reduced.



Fig. 6: Groper appliance

Bonded space maintainer --- Delivered to the patient in a single appointment, it eliminates the need for lab procedures, reduces plaque accumulation. Loop is bonded to permanent molars using a Single Bond® system and Tetric Flow® composite resin. Remaining procedures are same as that of conventional type band and loop SM. Isolation is one of the factor that affect longevity of this space maintainer ^[16].(Fig.7)



Fig.7: Bonded space maintainer

Pin and tube space maintainer -- It is used in cases where there is early loss of primary teeth. Pin is allowed to slide partially out of the tube in response to the lateral growth of the arch ^[17] .

Woven polyethylene fibers (ribbon) --- woven polyethylene fibers (RIBBOND) are placed as a space maintainer. It makes the technique relatively easy, fast, and the procedure could be completed in single appointment which required no lab services. Ribbon is placed on the abutment teeth. Flowable composite is applied on distal surface of abutment tooth and is cured ^[18]. (Fig.8)



Fig.8: Woven polyethylene fibers (ribbon)

Fiber reinforced composite” (FRC) loop space maintainer ---- Fibers and resin matrix are the 2 components that are involved in fiber reinforced composite. The resin matrix serves as a carrier, protector, and load-splicing medium around the fibers ^[2]. Framework of fiber reinforced composite loop is constructed using a commercially available polyethylene fiber system. Restorative composite resin added to the outer portion of the fiber. Abutment tooth are etched with phosphoric acid. Finally the loop is attached ^[19] to the abutment. It is used in the case of missing one or more primary molars functioned well during a short period. (Fig.9)



Fig.9: Fiber reinforced composite

Ez space maintainer ---- It is a traditional space maintainers with less time-consuming and cost effective. It can be used as an adjustable appliance by using the NiTi coil which is included in this space maintainer to regain some space and provides easy maintenance of the mesio-distal dimension of any lost, deciduous teeth ^[17]. Available in different colour and is a preformed one, length is adjusted using pliers and light cure adhesives are used to bond it ^[6]. (Fig.10)

Uses: Time saving one and easy to use.



Fig.10: Ez space maintainer

Cise space maintainer --- Cise maintainer consists of a main structure (S_{main}) and two substructures (S_{sub1} and S_{sub2}) with three screws (S1, S2, and S3). Material type of the maintainer is AISI 301 type stainless steel (DIN 1.4310) sheet ^[20]. It can be placed by inserting its posterior part into the bondable orthodontic band or tube. Its length and location can be adjustable for individual patient arch shape and space dimensions with respect to up righting the first molar and/or distal movement of molars ^[20]. (Fig.11)

Uses: no need for the bonding of mesial tooth, it can be easily autoclaved and sterilized.



Fig.11: Cise space maintainer

H-appliance --- It is a simple “bracket and hook” space maintainer. In this, stainless steel wire is adapted to the cast by making two clasps such as hooks on both abutment teeth. Into the distal hook a begg’s orthodontic bracket is inserted. By making a small pinhead loop near the distal interproximal space, distal end of the wire is bent and it is closely adapted on the palatal surface of the crown ^[21]. The bracket should always be positioned at the palatal or lingual aspect more mesially. (Fig.12)

It is cost effective, easy to fabricate, comfortable to wear, patient’s compliance is also better ^[21].



Fig.12: H-appliance

A novel, fixed chair side space maintainer---- This is a fixed space maintainer which represents a novel, straightforward, chair side made, and esthetic rehabilitation of missing tooth. In this light cured acrylic resin (LCAR) is prepared after measuring the distance between the buccal grooves of the lower first permanent molar and disto-buccal line angle of the first primary molar and is measured using a vernier caliper. LCAR is wetted with an adhesive (Adper Single Bond-2® 3M). From the buccal aspect of the permanent first molar to buccal aspect of the primary second molar a cut length of LCAR is placed on flowable composite ^[22]. (Fig.13)

Uses: easy to apply, solve the time issue, require only one visit, laboratory procedures not required.



Fig.13: A novel, fixed chair side space maintainer

Metal free space maintainer --- Custom made metal free CadCam devices, allow to produce safe appliances for special needs. From an intraoral scan is obtained a 1:1 Ist file of both dental arches. On the maxillary one, imported in a free CAD software*, design the custom space maintainer in order to achieve the best comfortable fit for the patient. The Ist file from the CAD phase is used to produce the custom made appliance by milling a machinable fiber reinforced composite material named Trilor TM^[23] .(Fig.14)

Uses: This space maintainer is totally metal free, esthetic, easy to clean, light, comfortable and really safe, particularly for some categories of patients who are allergic to metals, dental resins or who need to periodically undergo MRI in the head to monitor specific diseases as epilepsy or vascular problems.

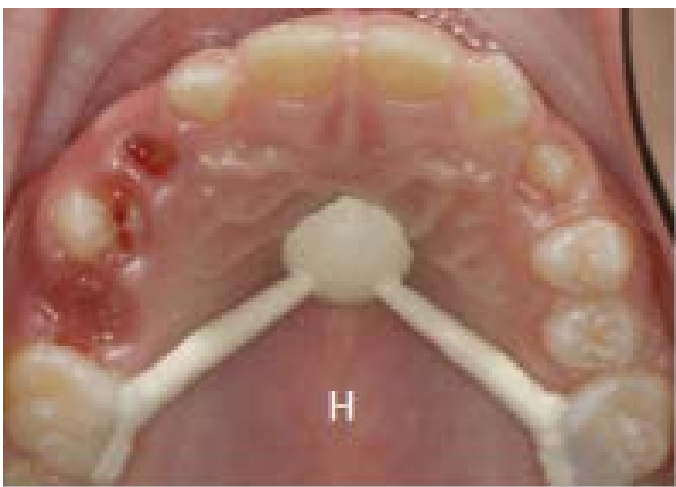


Fig.14: Metal free space maintainer

Conclusion

Researchers reported that fixed dental space maintainers are associated with their advantages and disadvantages. However, a knowledge of using appropriate appliance at the right time and then possessing the ability to inform the parent of the need for any future changes or modification is an important aspect of treatment planning especially with fixed space maintainers. So, proper diagnosis, thoughtful appliance design as to the value, limitations

and responsibilities with regard to the appliance are the key factors for success of space management.

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