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Recent innovations in space maintainers: A review

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Abstract
Deciduous dentition plays a vital role in the growth and development of a child. Premature exfoliation or extraction of deciduous tooth or teeth can frequently lead to the development of malocclusion. Space maintainers are appliances used to maintain space or regain minor amounts of space lost, so as to guide the unerupted tooth into the proper position in dental arch. Present review of literature provides information about indications, contraindications, types and recent designs of space maintainers used in Pediatric dentistry.

Keywords: primary tooth, premature exfoliation, space maintenance, space maintainer

Introduction

Deciduous dentition plays a vital role in the growth and development of a child. It not only helps in mastication, speech and esthetics but also maintains the space till the eruption of their permanent successors [1]. Premature exfoliation or extraction of deciduous tooth or teeth can frequently lead to the development of malocclusion [2]. Early loss of deciduous teeth causes shifting of adjacent teeth into the space created resulting in abnormal axial inclination, spacing between teeth and shifting of dental midline. This prevents the normal eruption and deviation of their permanent successors from their normal eruption pathways leading to malocclusion [3]. Early orthodontic interventions are often in the beginning of developing dentition help to promote favourable developmental changes [1].

Space maintainers are appliances used to maintain space or regain minor amounts of space lost, so as to guide the unerupted tooth into the proper position in dental arch. After the premature loss of a tooth, not only do space maintainers maintain function and preserve arch length integrity, they also maintain esthetics, prevent encouragement of detrimental habits and eliminate any potential psychological damage, a child could face as a result of the premature loss of teeth. The space maintainer also allows the permanent tooth to erupt unhindered into proper alignment and occlusion. The use of space maintainer appliance, or restoration of a carious primary tooth that can then act as a natural space maintainer, may potentially obviate the consequences of loss of arch length and the need for complex orthodontic treatment at a later stage [3].

The term space maintenance was coined by JC Brauer in 1941. He defined space maintenance as the process of maintaining a space in a dental arch previously occupied by a tooth or a group of teeth. Hence a space maintainer is used to maintain the space created by the lost deciduous tooth or teeth till the eruption of their successors. Boucher defined space maintainer as a fixed or removable appliance designed to preserve the space created by the premature loss of a primary tooth or a group of teeth [4].

Present review of literature provides information about indications, contraindications, types and recent designs of space maintainers used in Pediatric dentistry.

Classifications of space maintainers [5]

Table 1: Classifications of space maintainers

According to Hitchcock	According to Raymond C Thourow	According to Hinrichsen
▪ Removable or fixed or semi-fixed ▪ With bands or without bands ▪ Functional or non-functional ▪ Active or passive ▪ Certain combinations of the above	▪ Removable ▪ Complete arch Lingual arch Extra-oral anchorage ▪ Individual tooth	▪ 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-

Indications of space maintainers [4, 5]

1. If the space after the premature loss of primary teeth shows sign of closing.
2. If the use of a space maintainer makes the future orthodontic treatment simple.
3. When the succedaneous tooth is not ready for eruption.
4. When there is at least 1 mm of bone coverage over the space created.
5. After space analysis when there is possibility of space inadequacy for the permanent successor due to unbalance forces from the adjacent teeth.

Contraindications of space maintainers [4, 5]

1. No bone coverage overlying the erupting permanent successor.
2. When the root of the succedaneous tooth has 2/3rd completion.
3. When the succedaneous tooth is absent and the space needs closure.
4. When the space created is less than the mesio-distal diameter of the crown of the permanent successor.

Pre-requisites of space maintainers

1. Should maintain the mesio-distal dimension of the space.
2. Should be simple in construction.
3. Should be able to withstand occlusal forces.
4. Should not interfere or deviate the normal eruption path of the successor.
5. Should be easily adjustable.
6. Should not interfere in speech, mastication or deglutition.
7. Should be cost effective.
8. Should not promote food entrapment and promote easy cleaning.

Commonly used space maintainers in Pediatric dentistry [4]

1. **Removable non-functional space maintainer:** It is made of acrylic plate placed over the alveolar mucosa within the space created without any artificial teeth.
2. **Removable functional space maintainer:** It is made of acrylic place with artificial acrylic or composite teeth to replace the lost primary teeth. It is usually bilateral and used to restore esthetics and mastication.
3. **Band and loop space maintainer:** Most common fixed space maintainer indicated in single loss of primary molar or bilateral loss of single primary molar before the eruption of permanent incisors and loss of 2nd primary molar after eruption of 1st permanent molar. Modifications include crown and loop, crown-band and loop, Meyne's space maintainer, reverse band and loop, bonded band and loop, band and bar, long band and loop, NIMS modification etc.
4. **Nance palatal arch space maintainer:** Bilateral, non-functional, passive, maxillary fixed space maintainer indicated to stabilize maxillary 1st permanent molar in position when there is bilateral premature loss of primary teeth.
5. **Transpalatal arch space maintainer:** Unilateral, non-functional, passive, maxillary fixed space maintainer indicated to stabilize maxillary 1st permanent molar in position when primary molars require extraction.
6. **Distal shoe space maintainer:** It is also known as intra-alveolar appliance indicated when the primary 2nd molar is lost before the eruption of 1st permanent molar.
7. **Lingual arch space maintainer:** Bilateral, non-functional, active/passive, mandibular fixed appliance indicated in unilateral or bilateral loss of primary molars after the eruption of mandibular permanent lateral incisors.

Recent innovation in Space Maintainers

3D Band and loop space maintainer

The use of 3D printing in pediatric dentistry, initially, an ideal mixed dentition cast was poured of a standard dye, for a trial design of 3D printed SM by digital scanning and designing. The cast was scanned using a 3D digital dental scanner followed by the designing of the band and loop similar to the conventional SM, on the Dental CAD 2.2 Valletta. Two types of SMs were printed: (i) using titanium based powdered metal material by Micro Laser Sintering Technology which offers all benefits of an additive manufacturing process and (ii) using a clear photopolymer resin by Formlabs [6].

Fig 1: 3D Band and loop space maintainer

Advantage 3D Band and loop space maintainer [6]

- The use of digital designing of SM, and printing it by the help of 3D printer increases the precision of the appliance to the next level, minimizing human error.
- The extensive laboratory work, stabilizing the loop, and more importantly, soldering the loop on the band at two places and polishing, is also not required which saves chair side time.
- The appliance is printed as one unit minimizing the breakage, thus reducing failure of the appliance.
- Compared to a conventional appliance, a 3D printed model has a more complex structure with a higher level of detail.

CAD-CAM Band and loop space maintainer

BruxZir is a CAD/CAM-fabricated material and has to be digitally designed by a technician using a digital scanner and design software. The file was "nested" or positioned in the zirconia disk and milled to a full contour approximately 30 percent larger than the final restoration. Once the restoration was milled and removed from the disk, it was dipped in the appropriate colouring solution and sintered in an oven for 6.5 hours at 1,530 degrees Celsius where it shrunk to its final size. The gingival shade was added in the area of the missing tooth to enhance aesthetics. This

property gives it high impact resistance to the high masticatory forces in the mouth. It also has excellent resistance to thermal shock with a low thermal expansion which means the restorations will remain stable in the mouth on intake of hot and cold fluids. BruxZir is available in all the vita classic and gingival shades which would fulfill the aesthetic demands of the patient. Hence, BruxZir can consider as the ideal material for fabrication of the space maintainer [7].

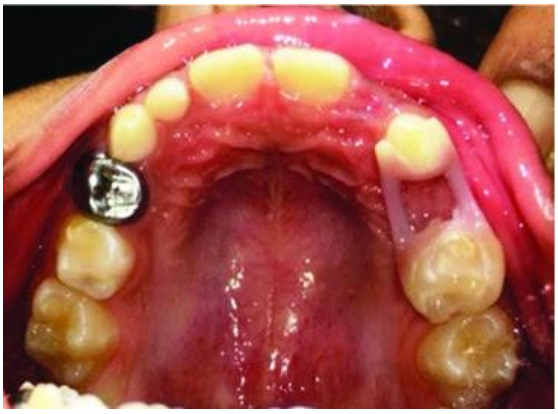

Fig 2: CAD-CAM Band and loop space maintainer

Advantages of CAD CAM Band and loop space maintainer [7]

- It has high strength due to monolithic design.
- There is no gingival lacerations and trauma as no band pinching is required.
- There is no nickel allergy and corrosion.
- The tipping of teeth is prevented as there is tooth support on the both sides.

Tube and Loop Space Maintainer

It is a tube and loop space maintainer designed by Srivastava N *et al*. (2016) also known as Nikhil appliance. It is less time consuming and does not require impression taking, lengthy laboratory procedure and soldering like the conventional band and loop space maintainer [8].

Advantage of Tube and Loop Space Maintainer [8]

- Innovative design of "Tube and Loop" SM is simple, quick and easy. It can be completed in a single sitting without any laboratory work.

Fig 3: Tube and Loop Space Maintainer

Functional Band and Loop space maintainer

The first step is to construct a conventional band and loop space maintainer in the region of premature tooth loss. This is followed by the placement of an acrylic tooth in the edentulous area of the cast and stabilization with modeling wax. The occlusion is then checked with the cast of the opposing arch and adjusted. Cold cure acrylic is used to attach the pontic to the loop. The completed appliance is then finished and polished. Trial fit is done in patient's mouth, and the appliance is checked for the presence of soft tissue irritation or occlusal interferences and adjusted accordingly. The final cementation of the appliance is done [9].

Fig 4: Functional Band and Loop space maintainer

EZ space maintainer

EZ Space Maintainer (Ortho Technology Inc.) is a cost effective, less time-consuming appliance than traditional space maintainers. It requires no impressions, no laboratory construction, and can be directly bonded during one in-office visit. It is more aesthetic, hygienic, simple and easy to use. It provides easy maintenance of the mesio-distal dimension of any lost, deciduous teeth and can be used as an adjustable appliance by using the NiTi coil included to regain some space [10].

Fig 5: EZ space maintainer

Fiber reinforced composite loop space maintainer

It is made of fibre reinforced composite resin usually developed to rectify the disadvantages of a conventional band and loop space maintainer. Subramaniam P *et al*. (2008) found Fiber reinforced composite loop space maintainer to be a suitable alternative to the conventional fixed space maintainer. These space maintainers are easy to apply and require only one visit. There is no need for making impressions and cumbersome laboratory procedures are eliminated. Patients are satisfied because these space maintainers are esthetic, less bulky, occupy less space in the oral cavity, and feel natural [11].

Pontic–Crown Fixed Space Maintainer

In the method, the adjacent tooth is crowned as an abutment,

and a SSC is soldered to it as a pontic form. In addition to maintaining space and preventing the tilt of the adjacent tooth, crown–pontic fixed-space maintainer prevents excessive growth of the opposite tooth and establishes the occlusion. Eshghi A *et al*. (2018) found Pontic–crown space maintainer as a suitable alternative for band and loop space maintainer in treating the early loss of primary molars.[12]

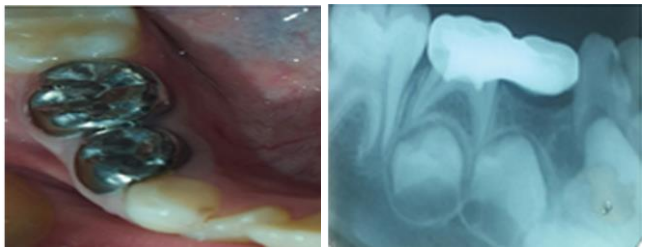

Fig 6: Pontic Crown Fixed Space Maintainer

Light Cure Acrylic Resin space maintainers

Souror YR *et al*. (2018) presented a case report in which a pink color sheet of LCAR Triad® VLC (Custom Tray) product was used to construct a space maintainer. After complete examination, full arch isolation was performed using rubber dam and suction. Both the abutment teeth were cleaned with pumice slurry and then etched with 35% orthophosphoric acid for 30 seconds for primary first molar and 20 seconds for the permanent first molar. The teeth were rinsed, air-dried, and wetted with an adhesive that was light-cured for 20 seconds. A thin layer of flowable composite was applied to the buccal surfaces of the abutment teeth without light-curing it. The cut length of LCAR was placed over the flowable composite extending from the buccal aspect of permanent first molar to buccal aspect of the primary second molar. The ends of the LCAR were adapted to the teeth surfaces with a plastic instrument. The composite and LCAR was light-cured for 2 minutes for each end of LCAR. Author found that the Light Cure Acrylic Resin space maintainers can be a new alternative to the traditionally fixed space maintainers used in pediatric dentistry [13].

Fig 7: Light Cure Acrylic Resin space maintainers

Conclusion

The best space maintainer is a well maintained primary tooth. But when these important natural space maintainers are lost, it is essential to implement a space management strategy. An early intervention with space maintainer is important when there is premature loss of primary teeth after considering the factors affecting planning of space maintainers.

References

1. Peter Schopf. Indication for and Frequency of Early Orthodontic Therapy or Interceptive Measures. Journal of Orofacial Orthopedics. 2003; 649(3):186-200.
2. Proffit W. Contemprorary Orthodontics. 2nd Edition, Mosby Year Book, 380-383.
3. Khanna P, Sunda S, Mittal S. “Keep My Space”- A Review Article. International Journal of Oral Health Dentistry, Jan-March. 2015; 1(1):11-15.
4. Singh PH, Naorem H, Devi TC, Debbarma N. Modern concepts of space maintainers and space regainers: A Review Article. Eur J Pharm Med Res. 2020; 7(3):176-178.
5. Marwah N. Text book of pediatric dentistry. 3rd Ed. Jaypee Pub, 2018.
6. Pawar BA. Maintenance of space by innovative three-dimensional-printed band and loop space maintainer. J Indian Soc Pedod Prev Dent. 2019; 37:205-8.
7. Soni HK. Application of CAD-CAM for Fabrication of Metal-Free Band and Loop Space Maintainer. J Clin Diagn Res. 2017; 11(2):ZD14-ZD16.
8. Srivastava N, Grover J, Panthri P. Space Maintenance with an Innovative “Tube and Loop” Space Maintainer (Nikhil Appliance). Int J Clin Pediatr Dent. 2016; 9(1):86-89.
9. Vinothini V, Sanguida A, Selvabalaji A, Prathima GS, Kavitha M. Functional Band and Loop Space Maintainers in Children. Case Reports in Dentistry, 2019.
10. Khanna P, Sunda S, Mittal S. “Keep My Space”- A Review Article. International Journal of Oral Health Dentistry, Jan-March. 2015; 1(1):11-15.
11. Subramaniam P, Babu G, Sunny R. Glass fiber–reinforced composite resin as a space maintainer: A clinical study. J Indian Soc Pedod Prev Dent. 2008; 26S3:98-103.
12. Eshghi A, Tayaran S, Mosleh H. The Longevity of Band and Loop and Pontic crown fixed space maintainer in children aged 4 to 7 years: A randomized controlled Trial. Dent Hypotheses. 2018; 09:90-5.
13. Souror YR, Khawandanah MS, Allam SE, Alaishan RA. Case report: A novel, fixed chairside space maintainer. Int J Pedod Rehabil. 2019; 4:80-3.