

Space Maintainers in Pediatric Dentistry

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Abstract

Introduction: It is always in the best interest of dentists to restore and retain defective primary dentition until it is time for their exfoliation. At the same, we hope that subsequent permanent dentition arises at just the right time. Nevertheless, many children either lose their primary teeth early, or there's a delayed eruption of permanent teeth. Such premature loss of primary dentition compromises the arch length and leads to malocclusions and tooth impactions. Interceptive orthodontic therapy with space maintainers can prevent such malocclusions caused by premature tooth losses [1].

Aim of Work: The aim of this study is to describe various types of space maintainer appliances used in pediatric dentistry.

Materials and Methods: This review is a comprehensive search of PUBMED from the year 1978 to 2020.

Conclusion: The untimely loss of a primary tooth can influence dental crowding, rotation, and impactions which can lead to malocclusions. Managing malocclusion in adulthood may require extensive orthodontic and surgical therapy. Space maintainer devices can intercept certain malocclusion in childhood if used at the appropriate time. Space maintainer devices come in various shapes and sizes, and each is used according to the problem encountered. They come as both removable and fixed as well as unilateral and bilateral. Conventional ones are designed and manufactured by hand in the lab, whereas CAD-CAM appliances are made using computer assistance. CAD-CAM appliances do have several advantages over conventional ones, and we may see their increased usage in the future.

Keywords: Space Maintainers; Band and Loop; Distal Shoe Space Maintainer; Lingual Arch; Nance Appliance; Transpalatal Arch; Digi-tainers

Introduction

Under a normal physiological process, children exfoliate their primary dentition and are subsequently replaced with permanent dentition. The timing for exfoliation and subsequent replacement with permanent dentition is of utmost importance. If the primary dentition is lost prematurely, there may be drifting of adjacent teeth and super-eruption of the opposite tooth leading to crowding and dental impactions. Premature loss of primary teeth could be physiological or due to dental caries, compromised periodontium, and trauma [1].

A pediatric dentist will try their best to restore and retain primary dentition until it's time for exfoliation, but it is often not possible. Extensive caries and compromised periodontium might force the dentist to prematurely extract the primary teeth. The resultant space

created must be maintained until the permanent tooth erupts. Several devices can be manufactured in the lab and be used as space maintainers with predictable results. In this review, we will discuss the most used space maintainer devices [2].

Classification

Space maintainers can come in various shapes and sizes. They can be broadly classified as removable and fixed and also can be grouped into unilateral and bilateral types. The time, the number of teeth lost, developmental stage, age, arch and occlusion and cooperative ability of the child determine the choice of space maintainer [3].

Removable space maintainers

As the name suggests, removable space maintainer devices can be worn and removed at patients' convenience. They are custom made using acrylic and wires on cast impressions of the patients. They can be further classified as:

- Removable unilateral/Bilateral space maintainers
- Removable Functional/Non-functional space maintainers.

Functional appliances are added with an acrylic tooth to incorporate both function and aesthetics. The downside to these appliances is poorer retention and lack of compliance among children. Retention of appliances may get lost due to repeated removal and wearing cycles as well as mishandling from children. These appliances often get lost by young patients, and many are unlikely to wear them as prescribed [4].

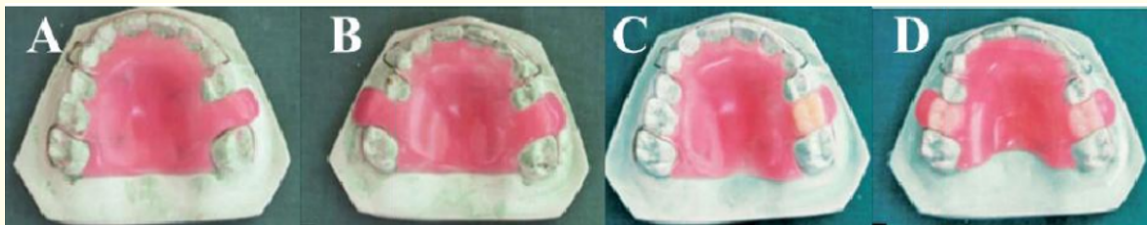


Figure 1: Nonfunctional: A. Removable unilateral, B. Removable bilateral. Functional: C. Removable unilateral, D. Removable bilateral [4].

Fixed space maintainers

Band/crown and loop type

It consists of a stainless-steel band or crown attached to the tooth adjacent to the edentulous area with stainless steel loop extending over the edentulous portion. The loop extension touches the tooth on the opposite side of the edentulous region and prevents any possible migrations. The band or crown is usually placed on teeth distal to the edentulous area, e.g. the band is placed on the first permanent molar and loop extending of extracted second primary molar and touching the first primary molar. First, a premade band or crown is placed on the adjacent tooth, and an impression is taken. Then, on the cast, stainless steel wire is shaped into a loop and soldered to the band [5].



Figure 2: Band and loop [6].



Figure 3: Crown and loop [6].

Distal shoe space maintainer

This is a special kind of fixed space maintainer where the deciduous 2nd premolar has exfoliated prematurely and the 1st permanent molar is yet to erupt in the oral cavity. Under normal circumstances, the 2nd deciduous premolar guides the eruption pathway of the 1st permanent molar as it has a tendency to erupt in a more mesial direction. In the absence of the 2nd primary molar, the 1st permanent molar might drift and erupt in its position, thereby crowding the arch and or obstructing the eruption of the 2nd permanent premolar. The appliance is made up of a band or crown for 1st primary molar with a loop spanning over the edentulous 2nd primary region. There also is an extension of loop directed apically and submerged beneath the gingiva contacting the mesial surface of unerupted permanent 1st molar, thereby guiding its eruption. The intragingival extension is removed once the permanent 1st molar has erupted, and the appliance continues to function like a regular band and loop type space maintainer. The major concern here is the possible risk of infection as the extension serves as a connection between subgingival tissue and the oral cavity, where maintenance of oral hygiene is of utmost importance [3].

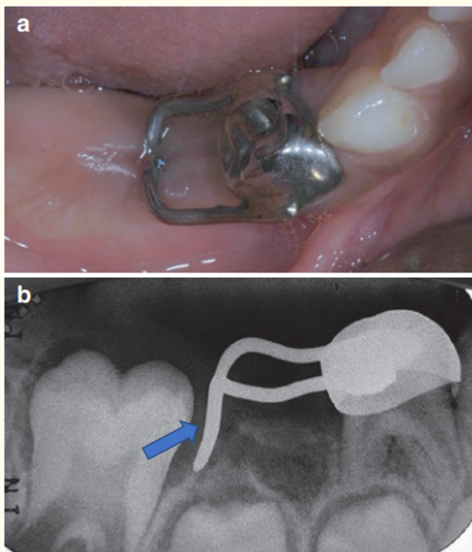


Figure 4: A: Distal shoe space maintainer (clinical picture). B: Distal shoe space maintainer (radiographic picture) The blue arrow marking the subgingival extension [6].

Fixed bilateral space maintainer

Lingual arch

It is an orthodontic appliance that connects molars bilaterally via a wire that runs across lingual surfaces of the anterior. It serves multiple functions, such as preventing mesial drifting of both molars and avoiding the lingual collapse of the anterior, thereby maintaining the arch perimeter. The lingual arch appliance is quite effective in the mandibular arch, also known as the Lower lingual arch. Typically, 1st permanent molars are banded or crowned bilaterally, and wire is placed along the lingual surfaces of mandibular teeth. The wire is soldered to the band or crown and thus maintains the arch perimeter until all permanent teeth have erupted [7].



Figure 5: Lower lingual arch space maintainer [7].

Nance appliance

It is a maxillary appliance, where bands are placed around the 1st permanent molars bilaterally, and wires soldered to them. The soldered wires extend anteriorly while embedding into an acrylic button that rests against the palate. The palatal tissue provides resistance against mesial migration of both molars bilaterally. The downside to this appliance is irritation on the palatal tissue as well as difficulty in oral hygiene maintenance [8].



Figure 6: Nance palatal arch [8].

Transpalatal arch

It is an anchorage reinforcing orthodontic appliance that connects maxillary molars bilaterally with a soldered stainless steel wire which hangs in mid-air. Apart from being a space maintainer, it also serves to derotate and intrude molars and can be administered as a habit breaker as well [9].



Figure 7: Transpalatal arch [9].

Drawbacks of conventional space maintainers [10]

Loss of retention and or decementation
Breakage of wires due to heating
Soft tissue injury due to poorly fitting appliances
Time-consuming process of manufacturing
Technique sensitive procedures which are prone to human errors
Metal allergy
Poorly compliant young patients

Digital space maintainer/digitainers

Numerous drawbacks associated with conventional space maintainers led to the development of space maintainers produced with CAD-CAM technology and biocompatible materials. Polyetheretherketone, aka PEEK polymer, is biocompatible, opaque, rigid, and has strong mechanical properties. It is tolerant to chemicals and temperature changes which gives it dimensional stability. Kun., *et al.* studied digitally manufactured space maintainers using PEEK polymer and reported a reduction of 75% in weight of the appliance when compared with conventional ones [11]. Guo., *et al.* did an *in vitro* study comparing the model fit of digitally produced PEEK polymer space maintainers with conventional ones and found the former to be superior [12].

Steps in fabrication space maintainer using CAD-CAM

- Step 1: Take dental impression and pour model. Scan the model with a digital scanner.
- Step 2: The object is scanned from all angles using light beams and miniature cameras. A virtual model is created by connecting dots and reconstructing them.
- Step 3: The clinician can use a CAD (Computer-Aided Design) software to view, analyze and design a very customized appliance.
- Step 4: The final design is sent to CAM (Computer-Aided Milling), where the appliance is manufactured by milling from a block [13].

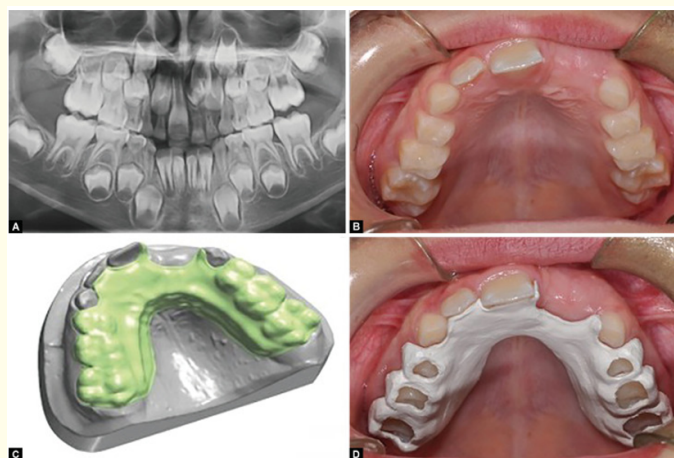


Figure 8: A: OPG of the patient. B: Intraoral picture ready for impression or direct scan. C: CAD (computer-aided designing). D: Final product after CAM (Computer sided milling) [13].

Advantages of digitainers [14]

Advantages	Impact
Esthetics	Acceptance among patients
Metal-free	Beneficial for people with metal allergy
Precision fit	Lesser chances of retention loss, decementation, or fracture
Reduced manufacturing time	Fewer visits to dental office and time saving
Single unit appliance	High strength of the device
Smooth surface	Easier to clean and maintain
Lightweight	More comfort for patients
No pinching of crown and band	Lesser trauma to soft tissues

Conclusion

The premature loss of a primary tooth can predispose to dental crowding, rotation, and impactions which can lead to malocclusions. Treatment of such malocclusions may require extensive orthodontic and surgical therapy. Interceptive orthodontics during childhood can prevent these malocclusions by using proper space maintainer devices. Space maintainer devices come in various shapes and sizes, and each is used according to the problem encountered. They come as both removable and fixed as well as unilateral and bilateral. Conventional ones are designed and manufactured by hand in the lab, whereas CAD-CAM appliances are made using computer assistance. CAD-CAM appliances do have several advantages over conventional ones and we may see their increased usage in the future.

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