

The Use of Space Maintainer in Pediatric Dentistry: A Systematic Review

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Abstract

Introduction: Primary teeth have an important role in directing the eruption of permanent teeth. Premature loss of primary teeth can lead to unwanted tooth movement resulting in loss of space in the permanent teeth. Space maintainer (SM) is a tool-based process that plays an important role in preventive and interceptive orthodontics during the start of primary teeth or premature loss in developing teeth. Space maintainer (SM) has been used when there is premature loss of primary teeth to avoid unwanted teeth movement and loss of arch length. **Objective:** To explore the use of space maintainers in pediatric dentistry. **Methods:** In the systematic review, the article search was performed on Pubmed, Elsevier, and Google Scholar. Study published on 2013 to 2020. 60 were articles assessed, including 60 articles from the electronic databases, 0 from the manual hand search. 50 records screened, 30 records excluded, 22 full-text articles assessed for eligibility and 15 full-text articles were included. **Results:** There were 15 articles about the use of space maintainer in pediatric dentistry. **Conclusion:** Based on 15 articles show that space maintainers are used in pediatric dentistry to preserve the space left by primary teeth that were extracted before the date of the teeth being removed.

Keywords: Space Maintainers, Pediatric Dentistry.

1. INTRODUCTION

Primary teeth have an important role in directing the eruption of permanent teeth. Premature loss of primary teeth can lead to unwanted tooth movement resulting in loss of space in the permanent teeth. This can have detrimental effects on the development of occlusion including crowding, impact or ectopic eruptions, and differences in median lines.¹

Respectively, the space maintainer (SM) is a tool-based process that plays an important role in preventive and interceptive orthodontics during the start of primary teeth or premature

loss in developing teeth. Space maintainer (SM) has been used when there is premature loss of primary teeth to avoid unwanted tooth movement and loss of arch length. These devices hold space so that the permanent teeth, when erupted, will not experience crowding, impact, or ectopic eruptions or differences in median lines. Therefore, space maintainers (SM) are used to maintain space. The factors that must be considered in choosing a space maintainer, type of maintenance, and specific indications for the use of this device.^{1,2,3}

Different types of space maintainers have been designed in the last three decades. Although these space maintainers are classified as fixed or removable space maintainers, all types are used to prevent loss of the curved perimeter.²

The aim of writing this systematic review was to explore the use of space maintainers in pediatric dentistry.

2. METHODS

Search Strategy

A search was performed on Pubmed, Elsevier, and Google Scholar. The study was published from 2013 to 2020. The following terms and keywords were used for the search: "Space Maintainer", and their respective search files, titles and abstracts are filtered and full text versions of articles that meet the criteria are downloaded. The flowchart in Figure 1 identifies included and excluded articles at each stage. 60 articles were assessed, including 60 articles from electronic databases, 0 from manual hand search. 50 records were screened, 30 records excluded, 22 full-text articles were rated for eligibility and 15 full-text articles included

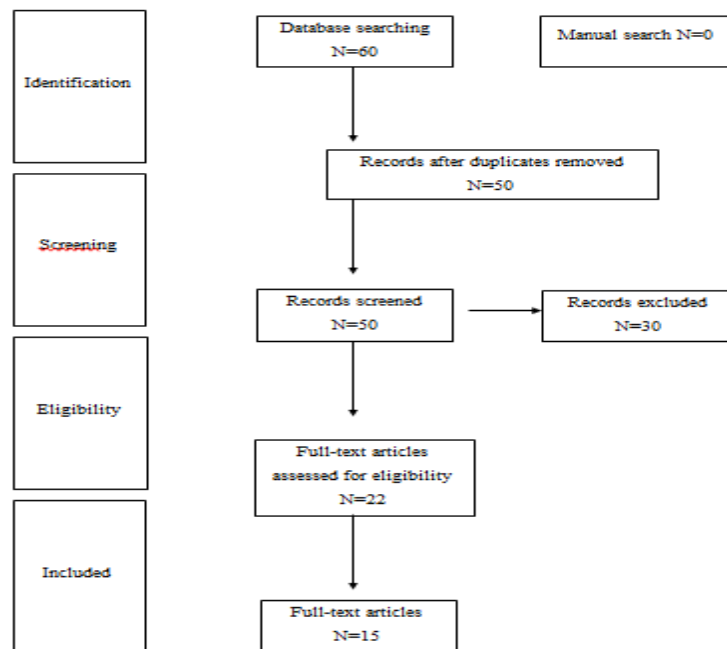


Figure 1: A flow chart describing the search methodology and the number of articles included/excluded at each stage

3. RESULTS

In a systematic review listed apathy of study options: the inclusion criteria for this review were 1) 2013-2020 articles, 2) English language, and 3) All study design and publication types were considered. The exclusion criteria were, studies that were not about Use of Space Mainainers in Pediatric Dentistry.

Table 1: Article about the use of space maintainers in pediatric dentistry

No.	Author	Year	Title	Conclusion
1.	Vikas Setia, Inder Kumar Pandit, Nikhil Srivastava, Neeraj Gugnani, Monika Gupta ⁴	2014	Band.ed vs Bonded Space Maintainers: Finding Better Way Out	Prefabricated band with custom made loop exhibited maximum success rate followed by conventional band and loop and then Ribbond. Minimum success rate was shown by Super splint. Banded space maintainers still remain the gold standard in the management of space in pediatric dental practice.
2.	Puneet Goenka, Aditi Sarawgi, Nikhil Marwah, Parvind Gumber, Samir Dutta ⁵	2014	Simple Fixed Functional Space Maintainer	To address the functional and esthetic problem associated with the loss of an anterior tooth, the present appliance was placed using a simple technique with an esthetic and functionally satisfactory result.
3.	V. Vinothini , A. Sanguida , A. Selvabalaji, G. S. Prathima, and M. Kavitha ⁶	2019	Functional Band and Loop Space Maintainers in Children	Managing space and at the same time improving the masticatory function and maintaining arch integrity in early loss of the primary teeth are challenging tasks. The functional band and loop space maintainer described in this report will be a good choice for use in premature loss of a single tooth in very young children.
4.	Bhaggyashri A Pawar ⁷	2019	Maintenance of space by innovative	Conventional band and loop has long been used for maintaining

			three-dimensional-printed band and loop space maintainer	space. The presented innovative digital design of 3D-printed SM is precise, quick, and easy.
5.	Shantanu S Deshpande, Vikas D Bendgude, Vivian V Kokkali ⁸	2018	Survival of Bonded Space Maintainers: A Systematic Review	The best design of the bonded appliance would be the one in which the components are not in the plane of occlusion, hence, an orthodontic stainless steel wire following the contours of the arch bonded to an abutment tooth would be ideal. Appropriate design and fabrication, meticulous oral hygiene maintenance, and regular follow-ups would certainly make bonded space maintainers a viable alternative to the conventional banded appliances.
6.	Mohamed Abd-Ellatif El-Patal, Moshabab A Asiry , Ibrahim AlShahrani, Samy Youssef El Bayoumy, Mohammed Abo-Elkasem Ahmed Wakwak, Mona Abdelghafar Mohamed Khalil ⁹	2018	The effect of fiber-reinforced composite versus band and loop space maintainers on oral <i>Lactobacillus acidophilus</i> and <i>Streptococcus mutans</i> levels in saliva	FRCR (INFIBRA®: Reinforcing ribbon, Bioloren, Italy) space maintainers are the best short-term alternative to prevent caries and space loss in children.
7.	MS Saravanakumar, Jayaraman Siddaramayya, Arunkumar B Sajjanar,	2013	Fiber Technology in Space Maintainer: A Clinical Follow-up Study	Ribbond® bondable reinforcement ribbon space maintainer can be accepted as a successful space maintainer only for short periods.

	Brinda Suhas Godhi N Simhachalam Reddy, Raju P Krishnam ¹⁰			
8.	Nikhil Srivastava, Jyotika Grover, Prerna Panthri ¹¹	2016	Space Maintenance with an Innovative “Tube and Loop” Space Maintainer (Nikhil Appliance)	The presented innovative design of “Tube and Loop” SM is simple, quick and easy. It can be completed in a single sitting without any laboratory work. The authors recommend that the appliance be fabricated routinely by dental practitioners as it offers more advantages over conventional SMs.
9.	Sudhir Mittal, Archana Sharma, Amit Kumar Sharma, Kamal Kishore Gupta, Ankita Gaur, Vasundhra Pathania ¹²	2018	Banded versus Single-Sided Bonded Space Maintainers: A Comparative Study	Patient acceptability for FRCR space maintainers was found to be significantly higher as compared to conventional band and loop space maintainers
10.	Martu Loana, Luchian Lonut, Danila Catalina, Martu Cristian, Barca Eduard, and Beldiman Maria- Antonela ¹³	2015	The Influence of Manufacturing and Material Quality on Space Maintainers Longevity	Premature loss of temporary teeth edentulous install transition state and impose immediate implementation of a space maintainer which avoids the consequences on the dynamics of eruption of permanent teeth and occlusal relationships.
11.	A. J. Ahmad, S. Parekh, P. F. Ashley ¹⁴	2018	Methods of space maintenance for premature loss of a primary molar: a review	C&L SMs have the best longevity and GFRCR SMs may be a longer lasting and safer alternative to B&L SMs. C&L SMs are recommended for loss of a primary first molar and

				GFRRCR SMs (placed under rubber dam) are recommended for loss of a primary second molar.
12.	Shilpa Hiremath, Abhishek Jairaj ¹⁵	2017	Cu-sil Denture- A Space Maintainer for Function- In Paediatric Patients	Cu-sil like denture not only acts as a removable functional space maintainer, but also promotes healthy stimulation of the mucosa to maintain alveolar bone to promote eruption of permanent teeth.
13.	Nurhat Ozkalayci, and Mehmet Yetmez ¹⁶	2018	New Design for an Adjustable Case Space Maintainer	Structural analysis shows that the space maintainer is stable and is used for maintaining and/or regaining the space which arouses early loss of molar tooth.
14.	M. A. Qudeimat, S. Sasa ¹⁷	2015	Clinical success and longevity of band and loop compared to crown and loop space maintainers	B&L had higher failure rate than C&L space maintainers. The main reason for B&L appliance's failure was decementation, and for C&Ls, it was solder breakage. The mean survival time for C&L space maintainers was statistically and clinically significantly higher than B&L space maintainers.
15.	Harleen Kaur Soni ¹⁸	2017	Application of Cad-Cam for Fabrication of Metal-Free Band and Loop Space Maintainer	The ceramic space maintainer seems to be a suitable alternative to the conventional band and loop space maintainer. The appliance is well tolerated by the patient and also gives the benefit of advanced aesthetics with improved strength.

4. DISCUSSION

One of the important functions of primary teeth is to occupy the physiological space and guide the eruption of the replacement teeth. ¹⁹ The dating of the primary teeth for the eruption of

the permanent teeth that form under them is a normal physiological process. If this process is interrupted, due to loss of primary teeth and proximal carious lesions, it can lead to mesial migration following the permanent teeth, resulting in malocclusion of crowding, impacted permanent teeth, formation of crossbites, differences in the median line of teeth, and supraeruption of the antagonistic teeth. It is also reported to have a negative impact on children's quality of life regarding emotional well-being.^{20,21,22,23}

The number of children affected by malocclusion due to premature primary teeth loss has increased significantly and is considered to be one of the most common dental problems along with dental caries, gingival disease, and dental fluorosis.²⁴

Space maintenance at the primary stage and at the mixed teeth stage is a major factor in preventive orthodontics and continues to play an important role in pediatric dental practice.²⁵ A space maintainer is commonly used in pediatric dentistry to preserve the space left by a primary teeth that is extracted before the date of the tooth's date.^{26,27} Space preservation has been emphasized from the start to avoid developing malocclusion features, and this can be achieved using SM.²⁸ Maintenance of arch length during primary teeth period, mixed dentition period, and permanent tooth period is very important for the development of normal occlusion in the future.²⁹ Therefore, primary teeth serve as the best space maintainer (SM) for permanent dentition.²⁰ Use of SM should be recommended, as preventing tooth movement and loss of the perimeter helps avoid these complications.^{17,26,30}

To facilitate musculoskeletal reconstruction, space maintainers have been utilized to preserve anatomy as well as function as local drug depots to treat local infections. Space maintainers have been used in a variety of anatomical disorders, including skull space, mandible, and joints.^{31,32}

A space maintainer (SM) is a fixed or removable device used to maintain the length of the arch after the loss or premature extraction of a primary teeth (due to trauma, damage, or other factors).^{29,33,34,35} The removable space maintainer can maintain the toothless space, restore masticatory function and aesthetics. However, the removable Space maintainer has some drawbacks such as poor retention, poor child tolerance, and a high probability of the tool getting loose.^{36,37,38} Meanwhile, the use of a fixed space maintainer would be more suitable for longer maintenance periods. The use of fixed space maintainers is well tolerated and durable. The fixed space maintainer should be removed once a year to allow examination, cleaning, and application of fluoride to the teeth.³⁶ However, basically any type of space maintainer can be used to prevent the loss of the curved perimeter.² The space maintainer can consist of different materials such as polymethyl methacrylate, cobalt - chrome, nickel - cobalt, and glass fiber. Because the space maintainer is in direct contact with the oral microflora, microbial biofilms can grow on its surface.^{39,40}

A study conducted in Iasi, Romania, by Martu et al. In 2015, assessed that among the selected treatment options, Martu et al applied two versions of the apparatus: type I (fixed space maintainer) and type II (removable space maintainer), which are the most common type most often applied in practice. A removable space maintainer was applied to 45 children, while a

removable space maintainer was included in the orthodontic appliance -54.¹³

For fixed space maintainers, Martu et al. Chose to apply the type of band with loop, or *orthodontic rings* with sliding elements - 25 and 12 such devices, (Table 2 and Figure 2).¹³

Table 2. Types of applied space maintainers/group of children¹³

Types of applied space maintainers	Group of children 136
1) Band + loop	25
2) Rings + sliding elements	12
3) Removable, included in the orthodontic appliance	54
4) Removable space maintainers	45

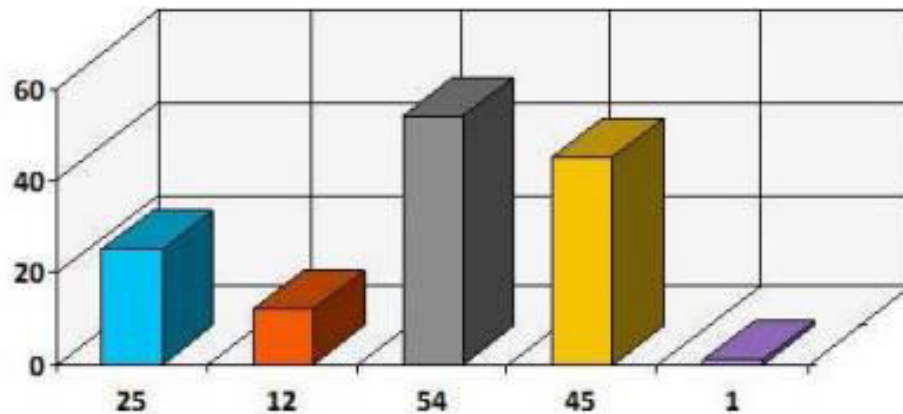


Figure 2. Graphical representation of space maintainers' typology applied in the study.

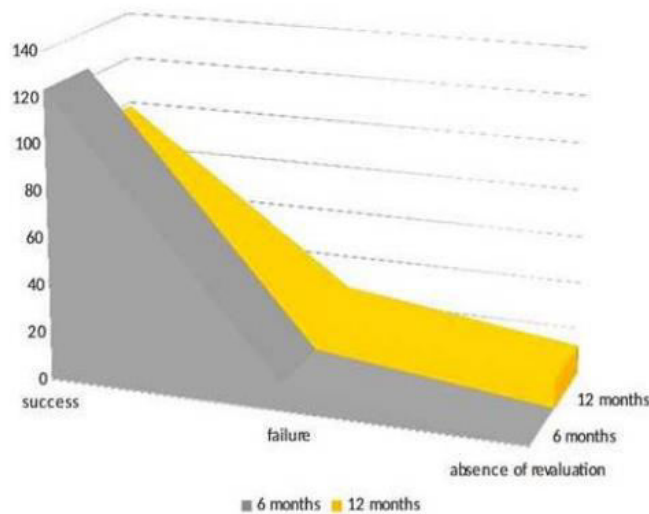
Source: (Loana Martu, Lonut Luchian, Catalina Danila, Cristian Martu, Eduard Barca, and Maria-Antonela Beldiman. The Influence of Manufacturing and Material Quality on Space Maintainers Longevity. 2015: 1294-8).¹³

Some studies have reported success rates as high as 91.5%, while other recent studies have reported that the rate will be below 27%. The most common reported reason for failure of fixed space maintainers, such as *orthodontic rings*, is loosening of the rings and *bands*.¹³

A study conducted in Iasi, Romania, by Martu et al. In 2015, found that 136 clinical cases were assessed by evaluating them as success or failure - during the first 6 months it was observed that a total of 124 patients (91%) were in good clinical condition, in terms of their the space maintainer, while 12 patients failed (9%). On further evaluation, after 12 months, the records proved to be changing: the success rate was 72%, while the failure rate was only 19%, (Table 3 and Fig. 3).¹³

Table 3. Findings of success and failure rates of space maintainers applied every 6 to 12 months.¹³

Evaluating time / Type of evaluation	6 months	12 months
• Success	124 (91 %)	98 (72 %)
• Failure	12 (9 %)	26 (19 %)
• Absence of reevaluation	0	12 (9 %)
Total	136	136

**Figure 3.** Gra
appl

e maintainers

Source: (Loana Martu, Lonut Luchian, Catalina Danila, Cristian Martu, Eduard Barca, and Maria-Antonela Beldiman. The Influence of Manufacturing and Material Quality on Space Maintainers Longevity. 2015: 1294-8).¹³

Meanwhile the current findings indicate a low level of experience with space management as well as an unsatisfactory level of awareness of the management of missing primary teeth, use of space maintainers and care and maintenance of space maintainers. Borrie *et al.* with a randomized sample of 400 general dentists in Scotland significantly found that the greatest barrier to providing interceptive orthodontic care was practitioners' lack of confidence in their chosen treatment plan.⁴¹

A study conducted in Saudi Arabia, by Alshehri and Nasim in 2015, assessed the knowledge and awareness of parents about their baby's oral health care in the Abha region. They found that out of 323 parents, only 77 participants (25.33%) had good knowledge of children's oral health. They further reported that children were more exposed to medical care but not to dental care at an early age, and that parents in Saudi Arabia had less knowledge and behavioral habits about their children's oral health.⁴² Therefore, parents should pay special attention to the oral health of their children. This is very important because studies have shown a low level of knowledge of parents regarding the maintenance of oral health of their

children.^{43,44}

Pediatric dentists play an equally important role in follow-up and oral health awareness for young patients and their parents. Appropriate patient education, routine check-ups, and follow-up as well as increasing public awareness about the maintenance and care of primary teeth and teeth in the mixed dentition period, especially room management are the main responsibilities of pediatric dentists.^{45,46,47,48,49,50}

5. CONCLUSION

Space maintainer at the primary stage and at the mixed dentition stage is a major factor in preventive orthodontics and continues to play an important role in pediatric dentistry. A space maintainer is used in pediatric dentistry to maintain the space left by a primary teeth that was extracted before the date of that teeth. Increasing awareness public about the maintenance and care of primary teeth and teeth during the mixed dentition period, especially space management is the main responsibility of pediatric dentistry.

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