CASE REPORT

Technological Advancement in Space Management—Prefabricated Space Maintainers: A Case Series

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Abstract

Premature loss of primary teeth in children may lead to space loss in the arch, which leads to the collapse of vertical and horizontal occlusal relationships in primary and permanent dentitions. The ideal method to preserve the space in the arch in such a scenario is to use a space maintainer appliance. Conventionally, band and loop space maintainers are the most commonly used space maintainers. However, these are associated with certain drawbacks, such as multiple appointments and extended time for fabrication. A novel invention in the form of prefabricated bands and loops has been made to offset these disadvantages. Placement of prefabricated bands and loops decreases the chairside time and omits multiple visits, hence aiding in better behavior management for the child. The present case series discusses five cases of prefabricated band and loop placement in pediatric patients.

Keywords: Band and loop, Case report, Prefabricated band and loop, Space maintainers.

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Primary dentition is critical to the development of the maxillofacial region through changes in mastication, speech, jaw growth, esthetics, and eruptive guidance of permanent successors. Premature loss of primary teeth in children, mostly due to caries and trauma, leads to the drifting of neighboring teeth into the empty space, leading to aberrant axial inclination, increase in inter-tooth space, and midline shift. This inhibits the physiological eruption of permanent successors due to interruption of the normal eruption pathway.[1] A collapse of horizontal and vertical occlusal relationship may also be an adverse consequence of space loss. Hence, it is imperative to maintain the space for the eruption of the succeeding permanent dentition.

Space maintainers are of various types, and the most commonly used fixed appliances are those with bands and loops. They are relatively inexpensive and easy to make. Conventional bands and loops (Fig. 1) have been used as space maintainers with certain advantages and disadvantages.[2,3]

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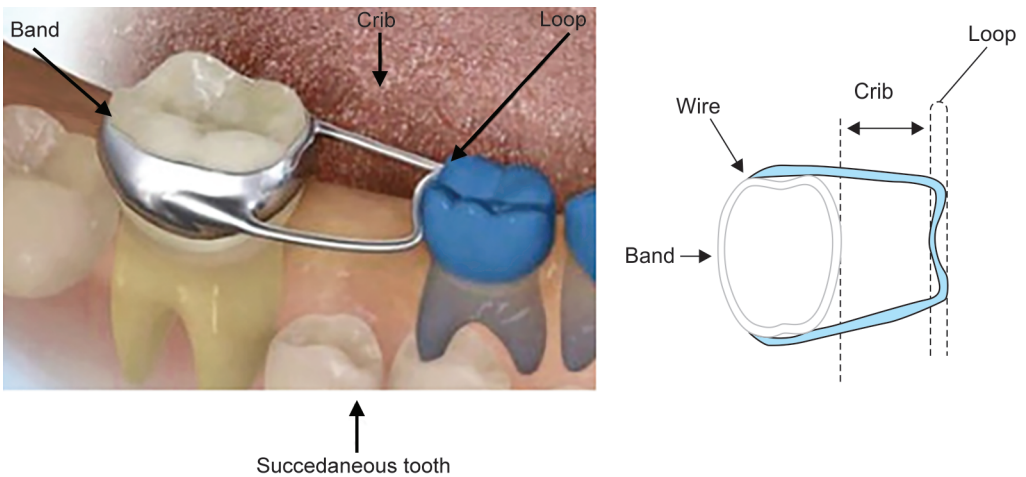


Fig. 1: Band and loop space maintainer; band: it is the part that is adapted onto the abutment tooth; it is made up of 0.005 inch thick stainless steel wire; the band is placed 0.5 mm subgingivally and occlusally; it is 1 mm below the marginal ridges; crib: it is that part of the space maintainer that spans the edentulous ridge; the crib follows the contour of the edentulous ridge and is placed 1 mm above it; loop: this part encircles the abutment tooth; it is 0.032 inches in diameter; the loop should be placed above the contact area

To offset the disadvantages of conventional space maintainers, one of the latest innovations in banded space maintainers is prefabricated space maintainers, which were introduced in the year 2017. They require only one appointment, no laboratory work, less time, and are affordable. Since prefabricated space maintainers are a novel invention, not many studies have been conducted to evaluate the success of these appliances. There also needs to be a scientific consideration of whether these appliances overcome the drawbacks associated with conventional band and loop appliances.

Case Description

The present case series consists of five cases of prefabricated band and loop space maintainer placement. A detailed case history was taken for each case, followed by a radiographic evaluation to assess the need for a space maintainer. Tanaka Johnston model analysis was performed in each case to assess whether any space discrepancy was present. This method utilizes the mesiodistal width of the lower four incisors to predict the width of unerupted permanent canine and premolar in a single quadrant. Oral prophylaxis and treatment guidance was given to every patient before placement of the space maintainer.

Design and Fabrication of Preformed Space Maintainer

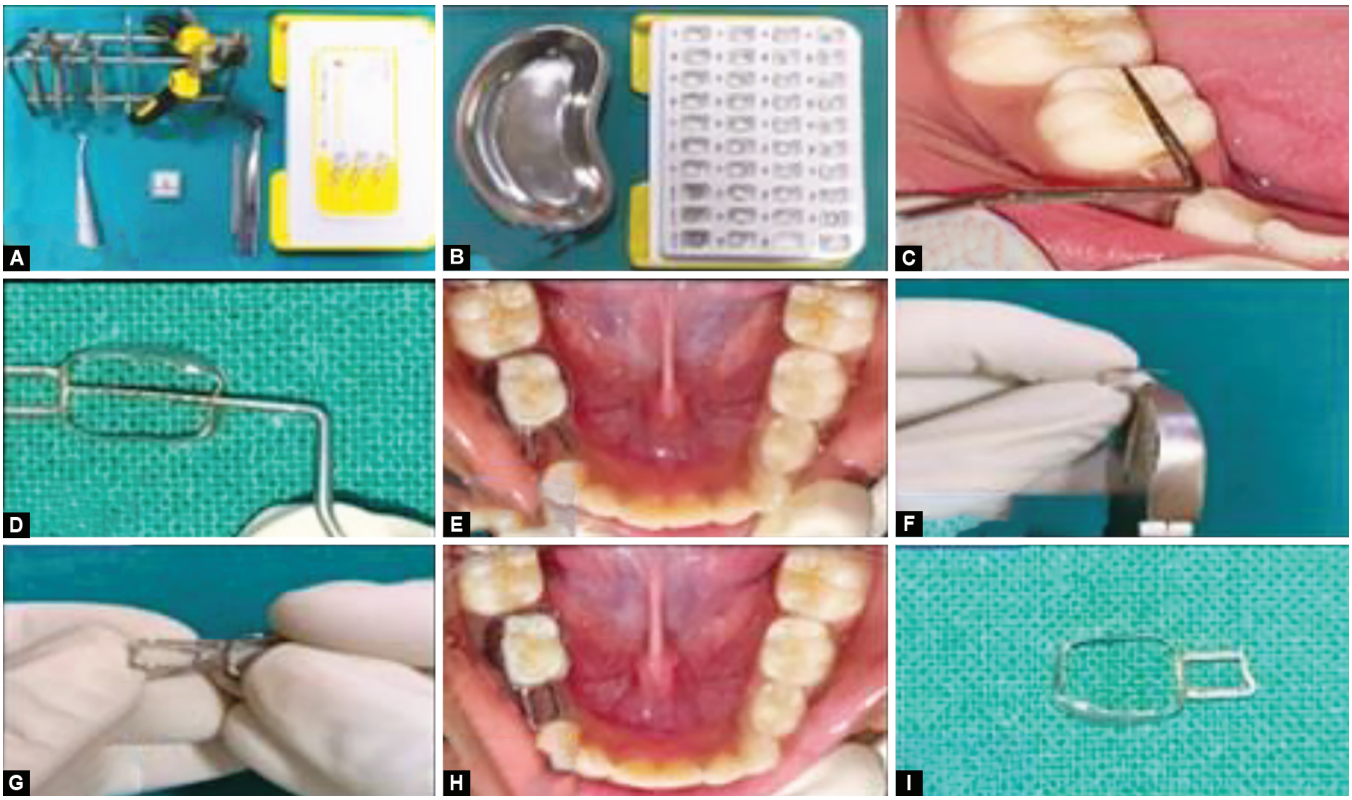
A prefabricated band of appropriate size was selected after measuring the mesiodistal diameter of the abutment tooth. Band coverage was assessed, and 1 mm subgingival extension was ensured. Burnishing was done against the grooves and against the contours of the band using a band pusher plier. Then, a loop was selected based on the mesiodistal space available and placed inside the band's tubes using a Howe plier, followed by the assembly on the abutment tooth. A radiograph was taken to ascertain the position of the appliance, followed by its cementation using type I glass ionomer cement (GIC). Patients and parents were given post-procedure instructions. The preformed space maintainer was part of the complete comprehensive dental management in all five cases, apart from other treatment modalities done as per the needs of each patient. The procedure is depicted in Figures 2A to I.

Case 1

An 8-year-old male patient reported pain in the upper left back tooth for a few weeks. Caries present in 16, 54, 64, 74, 75, 84, and 85. The restorable carious teeth (16, 75, and 85) were restored with GIC. The teeth that were nonrestorable, 54, 64, and 74, were extracted. Extraction was performed with respect to 74 under local anesthesia. The placement of the prefabricated band and loop space maintainer was done with respect to 75 (Figs 3A to H).

Case 2

A 7-year-old male patient had pain in the left lower back tooth region. Caries was present in 54, 65, and 84. During full mouth preparation, 54 and 65 were restored with GIC, and it was found that 84 were carious with furcation involvement and needed extraction. Extraction was performed with respect to 84 under local anesthesia, followed by a prefabricated band and loop space maintainer with respect to 85 (Figs 4A to H).



Figs 2A to I: (A and B) Armamentarium; (C) Assessing the mesiodistal diameter of the tooth; (D) Assessing the mesiodistal diameter of the band; (E) Checking the fit of the band; (F) Adjusting loop size; (G) Attaching the loop to the band; (H) Checking the fit of band and loop; (I) Adjusted band and loop for final placement

Figs 3A to H: (A) Intraoral preoperative maxillary occlusal view; (B) Intraoral preoperative mandibular occlusal view; (C) Intraoral frontal view; (D) Radiograph showing nonrestorable carious teeth with respect to 74 with furcal involvement; (E) Maxillary occlusal view after mouth preparation; (F) Mandibular occlusal view after mouth preparation; (G) Band and loop cementation with respect to 75; (H) Radiograph showing band and loop with respect to 75

Figs 4A to H: (A) Intraoral preoperative maxillary occlusal view; (B) Intraoral preoperative mandibular occlusal view; (C) Intraoral frontal view; (D) Radiograph showing nonrestorable carious teeth with respect to 84 with furcal involvement; (E) Maxillary occlusal view after mouth preparation; (F) Mandibular occlusal view after mouth preparation; (G) Band and loop cementation with respect to 85; (H) Radiograph showing band and loop with respect to 85

Case 3

An 8-year-old girl reported to the outpatient department with a complaint of pain in the right mandibular back tooth. Caries was present in 54, 64, and 74. During full mouth preparation, 64 were restored with GIC, and it was found that 54 and 74 were carious with furcation involvement and hence needed to be extracted. Extraction was performed with respect to 74 under local anesthesia, and a prefabricated band and loop space maintainer was placed with respect to 75 (Figs 5A to H).

Case 4

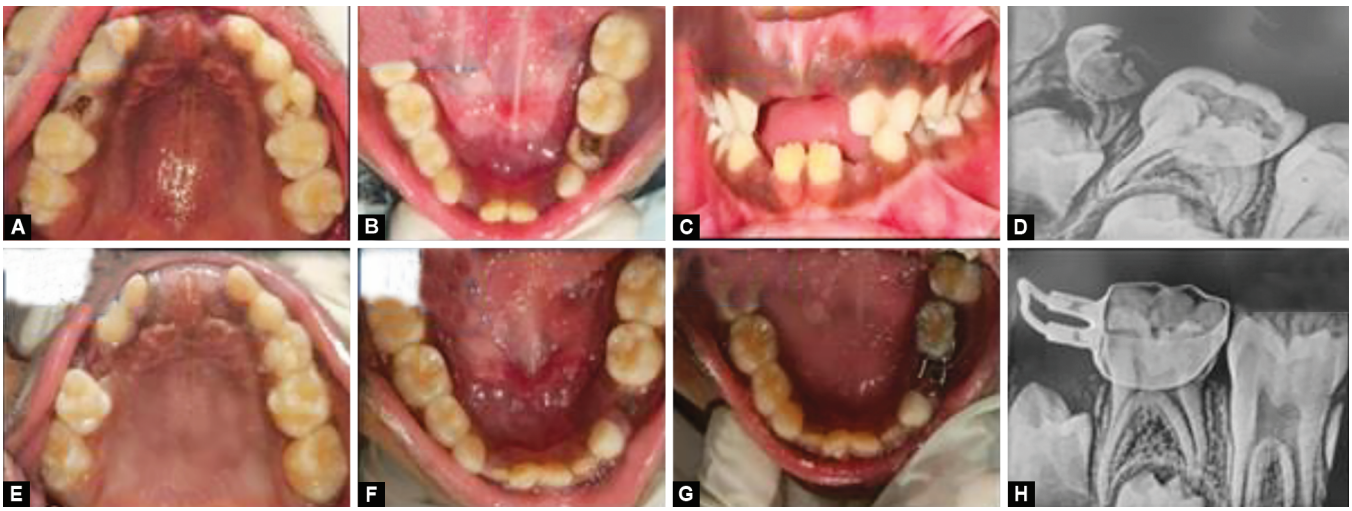
An 8-year-old boy complained of pain in the right first mandibular primary molar. Caries was present in 74, 75, and 84. During full mouth preparation, 74 and 75 were restored with GIC, and it was found that 84 was carious with furcation involvement and hence needed to be extracted. After extraction of 84 under local anesthesia, a prefabricated band and loop space maintainer was placed with respect to 85 (Figs 6A to H).

Case 5

A 7-year-old female patient came with severe pain in the lower right first primary molar. It was found that 84 was carious with furcation involvement and required extraction. This was followed by a prefabricated band and loop with respect to 85 (Figs 7A to H).

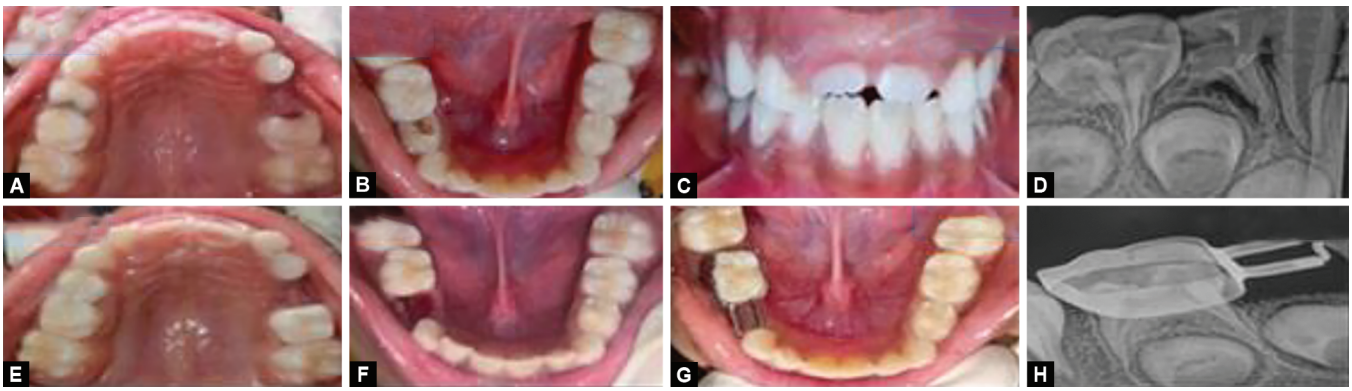
Discussion

Early loss of the primary tooth causes psychological, functional, and esthetic disturbances and space loss, which may later on result in malocclusion and functional disturbances. When posterior primary teeth are lost prematurely, a major orthodontic problem causing a lack of space for permanent dentition arises. According to Baume, approximately, 51% of first primary molars and 70% of second primary molars are lost prematurely, resulting in space loss and consequent aberrant eruption or impaction of a permanent tooth in that quadrant.[4] According to a study by Shamahy et al. in 2021, the prevalence of malocclusion among school children



Figs 5A to H: (A) Intraoral preoperative maxillary occlusal view; (B) Intraoral preoperative mandibular occlusal view; (C) Intraoral frontal view; (D) Radiograph showing nonrestorable carious teeth with respect to 74 with furcal involvement; (E) Maxillary occlusal view after mouth preparation; (F) Mandibular occlusal view after mouth preparation; (G) Band and loop cementation with respect to 75; (H) Radiograph showing band loop with respect to 75

Figs 6A to H: (A) Intraoral preoperative maxillary occlusal view; (B) Intraoral preoperative mandibular occlusal view; (C) Intraoral frontal view; (D) Radiograph showing nonrestorable carious teeth with respect to 84 with furcal involvement; (E) Maxillary occlusal view after mouth preparation; (F) Mandibular occlusal view after mouth preparation; (G) Band and loop cementation with respect to 85; (H) Radiograph showing band and loop with respect to 85



Figs 7A to H: (A) Intraoral preoperative maxillary occlusal view; (B) Intraoral preoperative mandibular occlusal view; (C) Intraoral frontal view; (D) Radiograph showing nonrestorable carious teeth with respect to 84 with furcal involvement; (E) Maxillary occlusal view after mouth preparation; (F) Mandibular occlusal view after mouth preparation; (G) Band and loop cementation with respect to 85; (H) Radiograph showing band loop with respect to 85

Table 1: Ideal requirements of space maintainer

Biocompatible material
Maintenance of the mesiodistal dimension of the space
Simple in construction
Resistant to occlusal forces
No interference or deviation of the normal eruption path of the successor
Easily adjustable
No interference in speech, mastication, or deglutition
Cost-effective
No food lodgement and easily cleanable
No interference in normal growth and function
Not exert excessive stress on adjoining tooth
Restoration of the function as far as possible

Table 2: Indications and contraindications of space maintainer

Indications
When the succedaneous tooth is not ready for eruption
When there is at least one mm of bone coverage over the succedaneous tooth
After space analysis, when there is a possibility of space inadequacy for the permanent successor due to unbalanced forces from the adjacent teeth.
If the space after the premature loss of primary teeth shows signs of closing
If the use of a space maintainer makes the future orthodontic treatment simple
Contraindications
When there is no bone coverage overlying the erupting permanent successor
When the root of the succedaneous tooth has two-thirds completion
When the succedaneous tooth is absent, and the space needs closure.
When the space created is less than the mesiodistal diameter of the crown of the permanent successor
Patients with widely spaced dentition
Patients whose succeeding teeth are expected to erupt within the next 6 months
Patients who have cuspal interferences or locked opposing first molars in a stable relationship
Patients who are expected to have future orthodontic procedures for any other indications are not recommended to place space maintaining appliances

Table 3: Classification of space maintainer

According to Hitchcock
Removable or fixed or semifixed
With band and without bands
Functional or nonfunctional
Active or passive
According to Raymond C Throw
Removable
Complete arch
Lingual arch
Extraoral anchorage
Individual arch
According to Hinrichsen
Fixed space maintainer
Class I
Nonfunctional
• Bar type
• Loop type
Functional
• Pontic type
• Lingual arch type
Class II
• Cantilever type
• Distal shoe
• Band and loop
Removable space maintainer
• Acrylic partial denture

Table 4: Indications of band and loop space maintainer

It is indicated for preserving the space created by the premature loss of a single primary molar
It is indicated for bilateral loss of a single primary molar tooth before the eruption of permanent incisors
It is also indicated when the second primary molar is lost after the eruption of the first permanent molar
Sometimes, it is given in cases of premature loss of primary canines
In most of the cases, the unerupted permanent molar (premolar) is usually not completely developed (root length is less than one-third) and will have >2 years of eruption time

is found to be 81.1% after premature extraction of the primary tooth.[5] The requirement for orthodontic treatment in the later stages of life is a time-consuming affair and also an economic burden in developing countries such as India. Table 1 presents the ideal requirements of a space maintainer.[6] Table 2 presents the indications and contraindications of a space maintainer. Table 3 mentions the classification of space maintainers.[7]

Fixed bands and loops are the most common fixed space maintainers in pediatric dentistry. Malik et al. in 2014 reported a success rate of 86.6% for conventional band and loop at 12 months follow-up.[8] The indications of band and loop are described in Table 4.[9] The advantages and disadvantages associated with the conventional band and loop space maintainers are enlisted in Table 5.[10]

In recent years, single-appointment prefabricated band and loop space maintainers have gained importance in dentistry. They do not require any laboratory work and can be placed quickly. They are affordable and help in better behavior management of the child. Setia et al. reported a high success rate of 92.3% with prefabricated space maintainers compared to 86.7% for the conventional types at 3, 6, and 9 months.[11] According to a study by Tahririan et al. in 2019, both conventional and prefabricated bands and loops showed a similar success of 100% in the 1st and 3rd month, which decreased to 96% in the 6th month and 92% in the 9th month.[12] The advantages and disadvantages associated with the preformed band and loop space maintainers are listed in Tables 6 and 7.

Apprehensive young children usually offer limited cooperation, leading to a demanding situation for conventional band formation

Table 5: Advantages and Disadvantages of conventional band and loop space maintainers

Advantages
It can be customized or modified according to individual needs
It has a good median survival rate
It is useful in uncooperative patients who will not wear removable appliances
The succedaneous teeth are well-guided to their positions
The jaw growth is not hampered
It is economical to construct
Disadvantages
These space maintainers are easily adjustable, but they are nonfunctional in nature
Dissolution of cement can lead to the dislodgement of the appliance
Failure of soldering leads to breakage of appliances in some cases
Decay on the sideline band also leads to the appliance being failed
The fabrication of the dental chair is time-consuming for the dentist and the patient
It requires at least two appointments
It may be difficult to fabricate in uncooperative children or children with a gag reflex
They are also technique-sensitive during different stages of the fabrication procedure, such as band displacement during cast pouring
These might interfere with the eruption of adjacent teeth

Table 6: Advantages and disadvantages of preformed band and loop

Advantages
It is useful in uncooperative patients who will not wear removable appliances
The succedaneous teeth are well-guided to their positions
The jaw growth is not hampered
Construction is simple
Affordable
Disadvantages
In preformed space maintainers, dislodgement might occur due to the decementation of bands and slippage of the loop
Cervical caries formation might occur under the bands
It might lead to the tipping of the abutment tooth due to undue forces if it is not placed properly
It is nonfunctional in nature
It is a newer method
Less availability of the preformed appliance in the market

and adaptation. The prefabricated space maintainers offer the advantages of being quick to adapt and hassle-free, especially for uncooperative children. Every case is unique; hence, the choice of space maintainers must be judged by the clinical presentation.

Table 7: Advantages and disadvantages of preformed band and loop space maintainer over conventional band and loop

Advantages
It is a single-sitting procedure
It requires no impression making
It requires less chairside time, hence aids in better behavior management of the child
In these appliances, many steps are either shortened or eliminated, such as the time required for the transferring and positioning of the band on the impression made, the pouring of the cast, the waiting period for its setting, and the removal and trimming of the cast is saved
The technique is accurate as markings are made intraorally and repeatedly confirmed for their correct position, unlike the conventional technique, which has errors related to impression-making and band dislodgement on the cast
This method can be easily mastered
It is less technique sensitive
Disadvantages
When the morphology of tooth deviates from the normal, preformed bands cannot be adapted over it. It requires the use of conventional bands

Conclusion

The introduction of prefabricated space maintainers in a variety of sizes overcomes the disadvantages of conventional space maintainers and affords convenience to both the dentist and the child. As the conventional band and loops require increased chairside time for fabrication, the child tends to get uncooperative during the procedure, and this negative experience instills a fearful attitude in the child toward future dental visits. Dental fear among young children is the main obstacle to the successful dental management of pediatric patients. Management of dental anxiety and fear is key to delivering effective dental treatment in pediatric dentistry.[13] Prolonged treatment time tends to make the child tedious and apprehensive. Placement of preformed bands decreases the chairside time and hence aids in better behavior management of the child. Long-term clinical studies are required for the comparative evaluation between the conventional and preformed band and loop space maintainers. In clinical scenarios, since the preformed band and loop demand less chair-side time, hence they are a promising modality as a space maintainer appliance.

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