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Review Article

Dentistry Section

Prefabricated versus Customised Space Maintainers in the Era of Evidence-based Dentistry: A Comprehensive Narrative Review

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ABSTRACT

Premature loss of primary teeth continues to be one of the most common challenges in paediatric dentistry, with wide-reaching consequences if left untreated. Space loss, midline deviations, crowding, and subsequent malocclusion often develop or develop frequently, often necessitating complex orthodontic treatment during adolescence. Space Maintainers (SMs) have therefore become a cornerstone of preventive paediatric dentistry. Customised appliances historically have been regarded as the gold standard because of their adaptability, long-term stability, and versatility across different clinical scenarios. In contrast, prefabricated SMs were developed as chairside alternatives that require less clinical time, eliminate laboratory steps, and improve feasibility for uncooperative children or in community settings. With the introduction of fibre-reinforced composite resin and Three-dimensional (3D) printing, the paradigm is shifting towards minimally invasive and aesthetic solutions. However, concerns remain regarding their longevity, adaptability, and impact on gingival health. The reviewed articles highlight the distinct advantages and limitations of both prefabricated and customised appliances, along with emerging evidence supporting fibre-reinforced and digitally fabricated SMs. Studies involving animal models and non-clinical narrative reviews were excluded. This narrative evaluation serves as a clinical reference for dental professionals and researchers seeking evidence-based guidance in appliance selection for paediatric space management and insight into future digital advancements in preventive orthodontics.

Keywords: Band and loop space maintainer, Orthodontic appliances, Paediatric dentistry, Premature tooth loss, Space maintenance

INTRODUCTION

Premature loss of primary teeth, whether caused by caries, trauma, or early extraction can lead to several long-term complications including mesial movement of adjacent teeth, reduction in arch length, crowding, ectopic eruption, midline deviation, impaction, and malocclusion. If left untreated, such sequelae often necessitate complex and costly orthodontic interventions during adolescence [1-3]. The maintenance of arch integrity during the mixed-dentition phase represents a cornerstone in paediatric dentistry, ensuring the orderly eruption of permanent successors [4-6].

To mitigate these risks, SMs have been used in paediatric dentistry since the mid-20th century. Conventional SMs have long been a mainstay in paediatric dentistry for managing premature tooth loss, owing to their proven success and reliability. They are highly effective in preserving space, avoiding undesirable tooth movement, and supporting normal occlusal development, while offering good durability and constancy when accurately fabricated and cemented. However, their use is limited by certain drawbacks such as lengthy fabrication procedures, multiple clinical visits, potential solder joint failures, and difficulties in obtaining precise impressions, particularly in children with a pronounced gag reflex [7,8].

Due to their limitations, clinicians have turned toward faster and more adaptable alternatives that streamline the procedure without compromising functional outcomes [9-11]. Prefabricated SMs were introduced to address the inherent limitations of conventional designs. These appliances can be conveniently fitted and cemented in a single appointment, eliminating laboratory steps and significantly reducing chairside time [12,13]. Their simplicity and efficiency make them especially valuable in emergency cases with uncooperative or anxious children and in public health or outreach programs where resources and time are often constrained [14-16].

However, despite their clinical convenience, certain limitations persist. Prefabricated appliances may not always achieve the same level of individual adaptation and marginal precision as customised counterparts [17-19]. Minor discrepancies in fit and adaptation that have been observed in comparison with conventionally fabricated or 3D-printed appliances, potentially affects periodontal health and longevity [20-22].

This narrative review critically compares prefabricated and customised SMs in paediatric dentistry, examining their clinical performance, benefits, limitations, complications, and patient-centered outcomes. By synthesising current evidence, it aimed to support informed appliance selection, enhance clinical decision-making, and identify key areas for future research.

Space Maintainers at a Glance

SMs play a crucial role in paediatric dentistry and interceptive orthodontics by preserving the arch length and guiding the eruption of permanent teeth into their correct positions [23,24]. SMs have been used in paediatric dentistry since the mid-20th century [25,26]. Over the years, multiple designs of SMs have been developed, broadly categorised into fixed and removable appliances. Removable appliances, although versatile and inexpensive, are limited by poor patient cooperation and higher failure rates. Within the realm of fixed appliances, two main approaches dominate clinical practice, which are customised SMs and prefabricated SMs [27-29].

Customised appliances especially the conventional Band and Loop (B&L) SM (C-BLSM) are considered the gold standard due to their individualised adaptation, longevity, and superior periodontal outcomes [30-32]. However, their limitations including technique sensitivity, laboratory dependence, multiple clinical visits, and

frequent failures due to cement dissolution or solder joint breakage, restrict their universal application [33-35].

Classification of Space Maintainers [24-26,32]

1. Based on design and placement:
    - Fixed Space Maintainers (SM): These are cemented to abutment teeth and include designs such as B&L, Crown and Loop (C&L), lingual arch, Nance palatal arch, and distal shoe.
    - Removable Space Maintainers (SM): Fabricated from acrylic resin and wire components.
2. Based on fabrication:
    - Prefabricated Space Maintainers (SM): These are preformed components- modified and fitted chairside, offering advantages such as reduced clinical and laboratory time.
    - Custom-made Space Maintainers (SM): These are fabricated in the dental laboratory based on individual impressions, ensuring superior adaptation and longevity.
3. Based on arch involved:
    - Maxillary or Mandibular SM's liable on the location of tooth loss.

An overview of kinds of SMs with examples, indications, advantages and limitations is presented below in tabular form [Table/Fig-1] [4,18,28,30,35,36].

Type of Space Maintainer (SM)	Examples	Indications	Advantages	Limitations
Fixed – unilateral	Band and loop (B&L), Crown and loop (C&L)	Premature loss of single primary molar	Premature loss of single primary molar	Risk of plaque accumulation, cement washout, or breakage
Fixed – bilateral	Lingual arch (mandibular), Nance palatal arch (maxillary)	Bilateral loss of primary molars in same arch	Maintains arch integrity; highly durable	Requires erupted permanent incisors for anchorage; difficult cleaning
Prefabricated	Preformed Band and Loop (B&L), stainless steel crown types	Emergency use or field settings requiring immediate fitting	Saves chairside time; minimal lab involvement	Requires adjustment for precise adaptation
Removable	Acrylic base plate with wire components	Multiple missing teeth; aesthetic or hygiene-sensitive cases	Easy to clean, adjustable, aesthetic	Requires patient cooperation; less durable; risk of loss
Fixed-distal extension	Distal shoe appliance	Early loss of second primary molar before outbreak of first permanent molar	Guides eruption path of foremost permanent molar; maintains arch length	Technique-sensitive; contraindicated in poor hygiene or medically compromised patients
Bonded	Fibre-reinforced composite loop, directly bonded wire	Short-term space maintenance; cooperative patients	Aesthetic, quick chairside fabrication, avoids banding	Limited longevity; prone to debonding
Custom-made	Laboratory-fabricated fixed or removable appliances	Long-term space maintenance requiring precision fit	Excellent adaptation, high durability	Requires impression and laboratory work; multiple visits

[Table/Fig-1]: Overview of Space Maintainers (SM)- Types, Indications, Advantages and limitation [4,18,28,30,35,36].

The SMs continue to aid as a cornerstone in the preventive and interceptive phase of paediatric dental care. Proper case selection, meticulous fabrication and consistent follow-up are essential for achieving optimal outcomes. Whether prefabricated, bonded or custom-made, their success largely depends on patient cooperation, oral hygiene maintenance and timely evaluation until the outbreak of the permanent successor tooth.

Customised Space Maintainers

Customised SMs have been the traditional standard of care in paediatric dentistry for decades. Among these, the band and loop space maintainer (C-BLSM) has remained the most widely used design, though several other customised options such as the crown-and-loop, distal shoe, lingual holding arch, and trans palatal arch are equally important depending on clinical requirements [6,10].

Design and variability: Customised SMs are fabricated using patient-specific impressions, followed by laboratory processing. The design is tailored to [6,27,32]:

- The location of the missing tooth (anterior vs posterior).
- The number of teeth lost (single vs multiple).
- The eruption status of adjacent and opposing teeth.
- The anticipated duration before permanent successor eruption.

Some common examples include the following:

- Band and Loop maintainer- single-tooth loss, especially in posterior regions.
- Crown and Loop (C&L) Maintainer- for teeth with extensive crown destruction requiring full coverage.
- Lingual Holding Arch- bilateral lower arch space loss or preservation of leeway space.
- Trans palatal Arch (TPA)- maxillary unilateral or bilateral space maintenance with good anchorage.
- Distal Shoe Maintainer- unique design for early loss of second primary molars before eruption of the first permanent molar.

Prefabricated Space Maintainers

Prefabricated SM (P-SMs) was introduced as a practical substitute to customised appliances, primarily to address limitations related to time, cost, and patient cooperation. Unlike customised appliances that require laboratory processing, prefabricated maintainers are supplied in kits with presized stainless-steel bands and loops that can be adapted chairside, allowing for single-visit delivery [1,15].

Design features: Prefabricated SMs typically include [1,15,16]:

- Preformed stainless steel bands of multiple sizes.
- Pre-contoured loops (stainless steel wire) ready for cementation.
- Crown-and-loop variants, where a preformed stainless-steel crown is combined with a loop to accommodate cases of severe crown destruction.

A comprehensive summary of prefabricated and customised SMs with respect to clinical survival, health of gingiva, patient/parent satisfaction, chair time, cost, aesthetics and complications as published in literature from 2016-2025 is provided in [Table/Fig-2] [1,4,9,11,14,17,37-41].

DISCUSSION

Customised SMs are individually fabricated after taking impressions of the child's dentition, ensuring that the appliance accurately confirms to the contours and occlusal pattern of the dental arch. Most commonly, they are constructed as band-and-loop designs in the laboratory. Tahririan D et al., (2019) and Deshpande SS et al., (2018) highlighted that customised maintainers demonstrate higher longevity and better gingival health outcomes than prefabricated ones when proper technique and follow-up are maintained [1,2]. Their precise fit minimises plaque retention and offers excellent retention over extended periods, often exceeding twelve months or until the outbreak of permanent successors [1,2,42-44]. Despite their

S. No.	Author (Year)	Origin	Publication Type	Objective	Methodology	Findings	Conclusion
1	Tahririan D et al., 2019 [1]	Iran	Prospective clinical trial	To assess the survival rate of prefabricated Band and loop (B&L)s in space maintenance of primary teeth and compare them with conventional Band and loop(B&L)s.	4-9-year-old patients meeting the inclusion criteria were divided into two groups. 1st group was conventional Band and loop (B&L) and the 2nd group was prefabricated Band and loop(B&L).	The survival rate of the conventional and prefabricated Band and loop (B&L) was 92% in the 9 months and no significant difference was witnessed in survival rates between the two.	Similar success proportion for the conventional and prefabricated Band and loop (B&L)s.
2	Setia V et al., 2014 [4]	India	Clinical study	To evaluate various SM in terms of survival rate, health of gingiva and occurrence of caries.	60 extraction sites (ages 4-9) were treated using 4 types of SMs: conventional, prefabricated, ribbond and super splint	Prefabricated bands with custom made loops showed the highest success (84.6%) and best health of gingiva, while super splints had the lowest success (33.3%) and poorest gingival outcomes (50%).	Prefabricated band with custom loop showed the highest success and best health of gingiva.
3	Barve K et al., 2025 [9]	India	Randomised control trial (split-mouth)	Compares prefabricated and conventional Band and loop (B&L) SMs on post extraction wound healing, plaque, and health of gingiva.	10 children (5-8 years) with bilateral mandibular molar extractions received conventional or prefabricated maintainers, with wound healing, plaque, and health of gingiva evaluated up to three months.	Both designs increased plaque accumulation and gingivitis, with conventional showing higher levels, though wound healing differences were not significant.	Prefabricated Band and loop (B&L) maintainers are an efficient and promising alternative to conventional designs
4	Dutta S et al., 2024 [11]	India	Original study	Compares and evaluate survival rate, health of gingiva, and acceptance of traditional vs. company-made Band and loop(B&L) maintainers in deciduous teeth.	50 patients aged 4-9 years with a missing deciduous first molar were included and divided into two groups: Group I – conventional B&L, Group II- prefabricated B&L and evaluated at 1st, 3rd and 6th month.	At 6 months, prefabricated B&L showed 100% survival, better health of gingiva (p=0.004), and higher patient acceptance, with no significant differences in failures compared to conventional B&L	Prefabricated B&L appliances are recently developed SMs that outperform conventional B&L appliances due to their improved design and higher success rate.
5	Thakur B et al., 2024 [14]	India	Randomised control trial	To compare and evaluate 3D-printed and conventional B&L SMs for managing early primary tooth loss in children.	62 children (6-12 years) were divided randomly into two sets: Group-I- traditional, Group-2- 3D-printed B&L SMs. Failure rates, health of gingiva, and patient satisfaction were compared between them at 3rd, 6th and 9th month.	Findings indicate that after 9 months, 3D-BLSMs achieved notably higher survival rates (77.4%), with significant differences observed at both 6 and 9 months.	3D-printed SMs provide enhanced long-term stability in minimising dental issues resulting from early loss of primary teeth.
6	Cengiz A & Karayilmaz H, 2024 [17]	Turkey	Prospective study	To evaluate and compare the clinical effectiveness, retention, and periodontal impact of Traditional Band-Loop (TBL) SMs with those fabricated using 3D printing.	70 children (mean age-7) were divided into two groups: Group-1-Laser sintering 3D printed group and Group-2-Traditional SMs. Retention, oral hygiene and impression preference assessed at 6 months.	Laser Sintered SMs had higher failure rates (66% vs 38%, p=0.007). Gingival Index and Plaque Index values increased on abutment teeth in both groups, with overall no differences.	Providing oral hygiene instruction prior to placing fixed SMs and increasing the use of digital workflows in paediatric dentistry are essential.
7	Ahmed MK et al., 2025 [37]	Iraq	Original study	To assess and compare the fit accuracy and Shear Peel Bond Strength (SPBS) of digitally fabricated {cobalt–chromium (Co-Cr) and polyetheretherketone (PEEK)} SMs with conventional SMs.	A total of 78 SM bands were fabricated and evaluated. Fit accuracy was assessed in 39 bands by calculating the root mean square (RMS) deviation from a master model using digital three-dimensional analysis. The remaining 39 samples were subjected to Shear Peel Bond Strength (SPBS) testing with a Universal Testing Machine (UTM), and the Adhesive Remnant Index (ARI) was documented following debonding.	Co-Cr and PEEK exhibited similar adaptation. However, bond strength was significantly higher in Co-Cr and stainless steel compared with PEEK. The Adhesive Remnant Index (ARI) distribution differed significantly among the three groups.	Digitally fabricated milled PEEK and SLM Co-Cr showed superior fit accuracy compared to conventional (stainless steel bands). Co-Cr and stainless steel exhibited higher bond strength than PEEK, with Co-Cr performing well in both adaptation and bonding, while PEEK showed excellent fit but lower bond strength.
8	Metkar S et al., 2025 [38]	India	Original study	To compare the fracture strength of conventional stainless-steel band-and-loop SMs with prefabricated (3D-printed) band-and-loop SMs produced using additive manufacturing.	15 conventional and 15 prefabricated (3D-printed) band-and-loop SMs were fabricated and tested for fracture strength using a Universal Testing Machine (UTM), with statistical comparison of mean fracture resistance based on reported mixed-dentition bite forces.	Prefabricated (3D-printed) band-and-loop SMs showed significantly higher fracture resistance (308.53 N) than conventional maintainers (130.85 N), indicating superior mechanical strength (p<0.05).	Prefabricated (3D-printed) band-and-loop SMs provide superior fracture strength when compared with conventional fabrication methods.
9	Kapoor S et al., (2025) [39]	India	Randomised controlled trail	This study compared the efficiency of Conventional band and Loop, Prefabricated band &Loop and 3D Band and Loop SMs concerning survival time, health of gingiva, and patient satisfaction.	60 healthy children aged 4-7 years requiring extraction of primary molars were arbitrarily divided into 3 groups of 20: Conventional band &Loop, prefabricated band &Loop, and 3D Band &Loop SMs. Evaluations were conducted at 1, 3, 6, and 9 months for survival, health of gingiva, and satisfaction.	85% of Conventional band &loop, 65% of 3D Band & Loop, and 30% of Prefabricated Band & Loop Space maintainer survived. Health of gingiva was similar with higher satisfaction for conventional Band and Loop (B&L) and 3D Band and loop (B&L).	Conventional and 3DBand &Loop SM proved to be clinically successful in terms of survival time, health of gingiva, and patient and parent satisfaction.

10	Tokuc M et al., 2022 [40]	Turkey	Original study	To assess the band fit of conventional and prefabricated (3D-printed) metallic band-loop SMs for clinical use.	16 digital intraoral scans were used to print resin models, and forty band–loop SMs were fabricated-20 conventional and 20 prefabricated (CAD/CAM). Band fit was assessed by visualising cement space with low-viscosity silicone and analysed using a dual-scan 3D method to calculate RMS values, which were compared between groups using Student's t-test ($p<0.05$).	No statistically significant dissimilarity was viewed between the conventional and prefabricated (digital) groups ($p=0.56$).	Within the study's limitations, conventional and prefabricated (CAD/CAM) SMs showed comparable band fit; further studies should evaluate characteristics such as fracture strength and patient comfort.
11	Khatab A et al., 2025 [41]	Egypt	Original study	To compare prefabricated (3D-printed) SMs with conventional metal band-and-loop SMs over a 6-month period.	20 children aged 4-8 years requiring space maintenance after early loss of a primary first molar in at least two quadrants were included. Conventional band-and-loop maintainers were placed on one side and prefabricated (3D-printed) maintainers on the other, with gingival health and retention evaluated over 6 months.	In terms of retention, the conventional band-and-loop SM performed better, whereas the prefabricated (3D-printed) SM was associated with reduced gingival inflammation.	The conventional band-and-loop SM is equally effective as the prefabricated (3D-printed) SM for use in young patients.

[Table/Fig-2]: Summary of comparative studies [1,4,9,11,14,17,37-41].

effectiveness, customised maintainers are technique-sensitive and require more time and resources. Albati M et al., (2018) and Samal S (2020) noted that multiple appointments, impression-taking, and laboratory fabrication increase clinical time and cost [6,10]. Common reasons for failure include cement dissolution, solder joint breakage, and band loosening, which can result in local irritation if not monitored regularly. However, these limitations are generally outweighed by their proven long-term reliability and favorable periodontal response. These appliances are most suitable for cooperative children and in settings where dental laboratories and skilled personnel are readily available, making them ideal for long-term space preservation and complex cases involving multiple tooth loss [6,10].

Prefabricated SMs were presented as a practical, time-saving alternative to overcome the limitations of customised appliances. They consist of presized stainless-steel bands and loops that can be adapted and cemented chairside within a single visit, eliminating the need for laboratory procedures [6,10]. Studies by Barve K et al., (2025) and Dutta S et al., (2024) demonstrated that prefabricated maintainers provide excellent short-term success, achieving survival rates above ninety percent within the first six months of use [9,11]. Parents and children often prefer these appliances because they require minimal chair time, fewer appointments, and immediate results. Their efficiency makes them particularly valuable in emergency cases, public health programs and among uncooperative children where a quick, effective solution is necessary. Patil A et al., (2024) further supported their practicality, reporting satisfactory performance and minimal complications even during a two-year follow-up period for prefabricated crown-and-loop variants [15].

Preformed SMs are particularly advantageous in children undergoing General Anaesthesia (GA) because chairside time must be minimised for them. The pre-fabricated design allows for rapid selection, minimal adjustments, and immediate cementation, thereby reducing operative duration and postoperative discomfort. Their standardised components also eliminate the need for multiple appointments, which is especially beneficial for young or medically compromised children requiring treatment under GA [45].

In distal shoe SM cases, preformed appliances also offer significant clinical value. Distal shoe maintainers are technique-sensitive and require precise subgingival extension to guide the eruption path of the unerupted first permanent molar. Preformed bands and prefabricated components provide predictable fit and stability, allowing easier adaptation and more accurate placement of the intraalveolar bar. This reduces the risk of improper eruption, mesial drift, and arch length loss. Additionally, preformed designs simplify postoperative monitoring and facilitate quicker replacement if the appliance become loose or dislodged [46].

Although prefabricated maintainers are convenient and clinically efficient, their adaptability and longevity are comparatively limited. Barve K et al., (2025) observed that poor marginal fit can lead to increased plaque buildup and gingival inflammation over time [9]. These appliances are more prone to decementation and loosening because they are not tailored to the patient's exact tooth morphology. Their use is therefore best restricted to short-term or transitional cases until a more durable customised or digitally fabricated maintainer can be provided [6,9]. Albati M et al., (2018) and Samal S (2020) also emphasised that while prefabricated maintainers are cost-effective in the short term, frequent replacements may increase overall cost and clinical effort in extended treatments [6,10].

Overall, evidence from these studies suggests that both customised and prefabricated SMs have distinct but complementary roles in paediatric dentistry. Customised maintainers remain superior for long-term stability, precise adaptation and maintenance of gingival health [1,2,6,8], while prefabricated maintainers offer unmatched clinical efficiency and patient comfort for short-term management. The optimal selection should be guided by the child's cooperation, clinical condition, available resources, and expected duration of space maintenance [9,10,12].

Limitation(s)

This narrative review is limited by the absence of a systematic methodology and quantitative analysis. Considerable heterogeneity among included studies, short follow-up durations, and limited high-quality evidence on newer digital SMs restrict direct comparisons and long-term conclusions. Further well-designed randomised clinical trials with standardised outcome measures are needed.

CONCLUSION(S)

The SMs remain essential in conserving arch integrity following premature loss of primary teeth. Evidence demonstrates that customised appliances continue to offer superior long-term stability, precision fit and periodontal health, making them ideal for extended space maintenance. Prefabricated maintainers, however, provide practical advantages in single-visit, emergency and resource-limited settings due to their efficiency and patient acceptance ` though their long-term performance may be compromised by decementation and limited adaptability. Advancements such as fibre-reinforced, CAD-CAM and 3D-printed maintainers show confident results in combining accuracy with convenience. However, multicentre randomised trials with bigger sample sizes and lengthier follow-

ups remain essential to validate these innovations and establish standardised protocols.

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