Lifespan of Chairside Band and Loop Space Maintainers

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Introduction

Premature loss of primary molars is a common occurrence in pediatric dentistry and has been consistently associated with a variety of undesirable sequelae. Early loss of primary molars can disrupt the balance of the dental arch, leading to mesial or distal drifting of adjacent teeth, tipping, loss of arch length, ectopic eruption of permanent successors, and ultimately the development of malocclusion [1,2]. These consequences may compromise both function and esthetics and often require more complex orthodontic treatment later in adolescence. Therefore, interceptive measures are essential to preserve arch integrity following premature tooth loss, and space maintenance appliances represent the standard of care in pediatric dentistry [1,2].

Space maintainers are designed to prevent space loss and maintain adequate room for eruption of permanent successors. These appliances may be classified as fixed or removable, and unilateral or bilateral. Common examples include band and loop, crown and loop, distal shoe, lingual arch, and transpalatal arch appliances [3]. In clinical practice, fixed unilateral appliances, particularly chairside fabricated band and loop space maintainers, are among the most frequently used due to their simplicity, cost effectiveness, and ability to be fabricated and delivered in a single visit [2,3]. This makes them especially useful in pediatric patients who may have limited cooperation for multiple visits.

Despite their widespread use, unilateral space maintainers have several notable limitations, most importantly their limited longevity and susceptibility to mechanical complications. Previous studies have demonstrated that many failures occur within the first year of placement, with a median lifespan of approximately 13 months [4,5]. The most common cause of failure is loss of cementation, while other reported complications include wire fracture, distortion, mechanical dislodgement, and soft tissue irritation [4,5]. Additionally, factors such as operator technique, patient cooperation, oral hygiene, and follow up compliance may influence appliance success [6].

Although numerous studies have evaluated the survival of space maintainers, many fail to distinguish between removal due to successful clinical outcomes and removal due to premature mechanical failure [6,7]. This lack of distinction limits the ability to accurately assess the true effectiveness of these appliances. Therefore, further evaluation of appliance longevity and failure patterns is necessary to provide clinically meaningful information and improve long term treatment outcomes.

Objective

The objective of this study is to retrospectively evaluate the clinical lifespan and failure modes of chairside fabricated unilateral band and loop space maintainers. This study also aims to assess potential factors associated with appliance longevity, including patient age, arch and side of placement, and to identify the most common causes of premature failure.

Study Design and Methods

This study is a retrospective chart review of pediatric patients who received chairside fabricated unilateral band and loop space maintainers at Montefiore Pediatric Dentistry clinics between April 2023 and April 2025. Electronic dental records will be reviewed to identify eligible cases with complete documentation of appliance placement and follow up visits. Inclusion criteria consist of patients who received a chairside fabricated unilateral band and loop space maintainer with adequate documentation of placement and follow up, allowing the appliance to be monitored until removal, natural exfoliation, or documented failure. Exclusion criteria include laboratory fabricated appliances, appliances placed under general anesthesia or oral conscious sedation, cases lacking sufficient follow up documentation, and patients lost to follow up before three months.

Data collected will include patient demographic information such as age and gender, appliance characteristics including arch and side of placement and tooth involved, and clinical variables including dates of placement and removal. The duration of appliance survival will be calculated in months from placement to removal. Failure types such as loss of retention, band fracture, distortion, and soft tissue irritation will be recorded, along with the reason for removal categorized as either clinical indication or mechanical failure.

Study Design and Methods

Outcome classifications were defined as follows:

- Censored: Appliances that remained functional at the last documented follow up and were not considered failures during Kaplan–Meier time-to-failure analysis.
- Success: Appliances that remained functional until eruption of the permanent successor or were removed due to a clinical indication, including stable space maintenance without risk of adjacent tooth drifting, absence of active infection, and functional occlusion.
- Failure: Appliances that lost function prematurely due to loss of retention, band fracture, distortion, or soft tissue complications requiring removal before the intended treatment period.

The primary outcome of this study is appliance longevity measured in months, while secondary outcomes include the frequency and type of failure modes associated with these appliances. Kaplan–Meier time-to-failure analysis will be used to evaluate appliance longevity, with removals due to clinical indication treated as censored observations.

Results

Data collection and statistical analysis were completed for 91 chairside fabricated unilateral band and loop space maintainers that met inclusion criteria. Final outcomes evaluated appliance lifespan, frequency of failure modes, and reasons for appliance removal, distinguishing between removals due to clinical indication and premature mechanical failure using descriptive statistics and Kaplan–Meier survival analysis.

Of the appliances included in the study, 26 (28.6%) experienced premature mechanical failure, while 31 appliances (34.1%) were classified as successful, remaining functional until eruption of the permanent successor or removal due to clinical indication. Additionally, 34 appliances (37.4%) were categorized as censored observations, including appliances removed due to clinical indication or those remaining functional at the last documented follow up and therefore not considered failures during Kaplan–Meier time-to-failure analysis.

The mean observed appliance duration was 11.3 months, with a median observed duration of 10.7 months. Kaplan–Meier time-to-failure analysis demonstrated an estimated median appliance survival of 25.3 months, with removals due to clinical indication treated as censored observations.

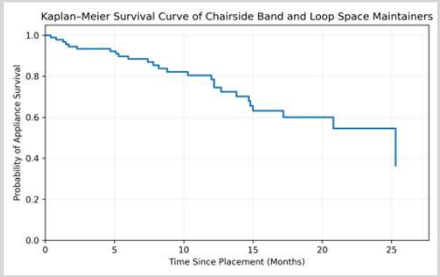
Patterns of failure differed from those reported in prior literature. The most common mode of premature failure was soft tissue irritation (50.0%), followed by loss of retention (34.6%), distortion (7.7%), band fracture (3.8%), and miscellaneous causes (3.8%).

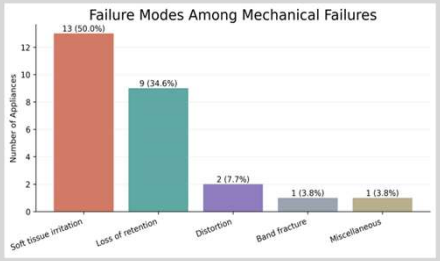
Appliances were more commonly placed in the mandibular arch (58.2%) than the maxillary arch (41.8%), while right and left side placement were similarly distributed. No statistically significant association was identified between appliance longevity and arch of placement, side of placement, or gender. However, a trend toward significance was observed for same day fabrication ($p = 0.085$), suggesting a possible influence on appliance longevity.

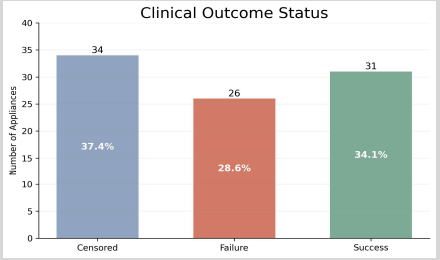
Outcome Status	Number of Appliances	% of Total
Censored	34	37.4%
Failure	26	28.6%
Success	31	34.1%

Variable	Category	Success	Failures	Failure %
Same-day fabrication	N	53	16	30.20%
	Y	38	10	26.30%
Side	Left	45	14	31.10%
	Right	46	12	26.10%
Gender	F	47	14	29.80%
	M	44	12	27.30%
Age group	6–7	44	14	31.80%
	8+	14	1	7.10%
	≤5	33	11	33.30%

Results







Discussion

Chairside fabricated unilateral band and loop space maintainers are widely used in pediatric dentistry due to their effectiveness in preserving arch space following premature tooth loss [1,2]. However, their longevity remains influenced by appliance design, cementation technique, patient related factors, and follow up compliance [3,4]. In contrast to previous studies that identified cement loss as the most common cause of failure, the present study found soft tissue irritation to be the predominant mode of premature failure, followed by loss of retention, distortion, and band fracture [3–5]. These findings may reflect variability in appliance adaptation, gingival impingement, oral hygiene, and compliance with recall visits.

The present study demonstrated an estimated median appliance survival of 25.3 months, exceeding the approximately 13 month median lifespan previously reported for unilateral appliances [4,5]. This difference may be explained by the methodology used in the present study, which distinguished successful clinical removals from true mechanical failures. In accordance with the study methodology, appliances removed due to clinical indication, including eruption of permanent successors or stable space maintenance, were treated as censored observations rather than failures during Kaplan–Meier time-to-failure analysis, providing a more clinically meaningful evaluation of appliance longevity.

Although no statistically significant association was identified between appliance survival and arch, side of placement, or gender, a trend toward significance was observed for same day fabrication ($p = 0.085$), suggesting procedural factors may influence long term success. Same day fabrication may present additional challenges such as bleeding at extraction sites, moisture contamination, and limitations in patient cooperation.

Additionally, because appliances in this study were fabricated and placed by multiple pediatric dental residents under faculty supervision, varying levels of provider experience and operator technique may have influenced appliance adaptation, cementation quality, and overall longevity, representing an additional source of variability.

The limitations of this study include its retrospective design, relatively limited sample size, and provider variability, which may have influenced appliance outcomes. Although the study was designed with an anticipated sample size of approximately 200 appliances, only 91 met final inclusion criteria at the time of analysis. In addition, factors such as oral hygiene, patient cooperation, and follow up compliance could not be fully standardized or consistently evaluated through retrospective chart review. Therefore, findings should be interpreted cautiously. Additional studies with larger sample sizes and longer follow up periods are warranted to further investigate factors associated with appliance longevity and failure.

Conclusion

Chairside fabricated unilateral band and loop space maintainers continue to play an essential role in preserving arch space following premature loss of primary teeth [1,2]. The findings of this study demonstrated favorable appliance longevity when removals due to clinical indication were distinguished from premature mechanical failures.

Soft tissue irritation represented the most common mode of failure, emphasizing the importance of proper appliance adaptation, cementation technique, and routine follow up care. Distinguishing between clinical success and true mechanical failure provides a more accurate understanding of appliance effectiveness and may help improve evidence based treatment planning and long term management of pediatric patients requiring space maintenance.

References

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