

Survival and clinical evaluation of various space maintainers used for early primary tooth loss

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Abstract

Aim: This retrospective study investigated the survival rate and clinical performance of space maintainers fitted in 50 patients aged from 6-11 years in the Department of Pediatric Dentistry at Selçuk University, Faculty of Dentistry between 2016 and 2019.

Methodology: Sixty-one subjects were included in the study. The clinical examination included performing the gingival index (GI) and the plaque index. The values of the indexes were determined and compared, and the failures of retainers were recorded and analyzed in terms of survival.

Results: Follow-up loss occurred in 18% of 61 space maintainers. A total of 10% of the evaluated 50 space maintainers had failed due to breakage. By using the Kaplan-Meier method, the estimated mean survival time for space maintainers was 13 months. Lingual arches had the lowest mean survival time of 12 months. Band and loops and removable partial dentures had a similar probability of survival. A significant decrease was observed in the time-dependent evaluation of the means of plaque and gingival indexes; however, no significant difference was found between space maintainer types.

Conclusion: The successful use of space maintainers for the premature loss of primary tooth space is achieved by regular follow-ups with the patient's parents, patient cooperation, and proper space maintainers and choice of material.

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Introduction

The exfoliation of primary teeth and permanent teeth eruption is regarded as a normal physiological process. This process may be disrupted because of factors including premature loss and proximal carious lesions. This disruption may cause arch length loss with mesial migration as well as malocclusion, crowding in permanent dentition, and opposing teeth supraeruption. These problems can be prevented in such ways as ensuring that primary teeth stay in the

mouth until the normal exfoliation time. Therefore, primary teeth are considered the best space maintainers for permanent dentition. However, the maintenance of arch space with the help of a space maintainer is alternatively regarded as the best and safest option for the unpreventable premature loss of primary teeth (1-4).

Space maintainers are generally categorized into two types: removable and fixed space maintainers. Removable space maintainers have both advantages and disadvantages. Their advantages are that they are

usually functional and easy to clean, the latter of which can help in maintaining good oral hygiene. A disadvantage is that the success of these removable appliances requires patient compliance and can thus pose a serious problem. Another disadvantage is that these appliances can be fractured or misplaced (5-9).

Fixed space maintainers sustain the space created by the unilateral/bilateral premature loss of primary teeth in either of the arches. One of the most frequently used types of space maintainers is the band and loop, which has been used over a long time with high success rates (10-12). However, there are disadvantages associated with it, including the disintegration of cement, solder failure, caries formation along the margins of the band, and a long construction time despite good patient compliance (13-15).

The most significant factor in determining bonded appliance success is the survival of the space maintainer until succedaneous tooth eruption because the primary function of space maintenance is measured by it. Many options exist for designing different types of space maintainers, and each type has advantages over the others. Comparative studies regarding the efficacy of space maintainers are lacking in the literature (16-19). The evaluation of various space maintainers in terms of survival rate, gingival health, and plaque index forms the basis for the present study.

Materials and Methods

The study was based on 61 space maintainers (28 band and loops, 18 lingual arches, and 15 removable) in 50 patients aged 6 to 11 who were invited for routine examinations after space maintainer applications treatment at Selçuk University, Faculty of Dentistry, Department of Pediatric Dentistry. The study protocol was submitted to the local Ethics Committee, and permission was obtained to carry out procedures (Decision no: 2021/23). Instructions for oral hygiene and appliance maintenance were given to children and their parents. Patients were recalled at three-month periodic intervals for the evaluation of space maintainers using the following criteria. Clinical evaluations of the patients were performed by visual and tactile examinations to check for survival rates, plaque indexes, and gingival health at all recall periods.

The survival rate was controlled following comparable criteria, such as Unsuccessful (F) and Success (S). Gingival health and plaque deposition were assessed according to the index used by Silness and Loe (Tables 1 and 2). A sterile periodontal probe was used in dental plaque and gingival index measurements. Separate scores were obtained for each tooth. Two pediatric dentists (Ö.S. and T.G.) performed dental plaque index and gingival index measurement examinations. Prior to the study, two training sessions for calibration were conducted on 10 patients each.

Table 1. The Silness-Loe plaque index

Plaque Index	Criteria
0	Absence of microbial plaque
1	Thin film of microbial plaque along the free gingival margin
2	Moderate accumulation with plaque in the sulcus
3	Large amount of plaque in sulcus or pocket along the free gingiva margin

Table 2. The gingival index of Loe and Silness

Scores	Gingival Status	Criteria
0	Normal gingiva	Natural coral pink gingival with no e/o inflammation
1	Mild inflammation	Slight changes in color, slight edema. No bleeding on probing
2	Moderate inflammation	Redness, edema and glazing. Bleeding upon probing
3	Severe inflammation	Marked redness and edema/ulceration/tendency to bleed spontaneously

Statistical analysis

Data analysis was undertaken using the SPSS software version 18.0 (IBM SPSS Inc., Armonk, NY, USA). Descriptive analysis was performed on all values obtained, and the Kolmogorov-Smirnov test was used in

the assumption of normality analysis. The data collected at all recall periods was then tabulated. The Kruskal-Wallis test was used for statistical analysis. The survival rate of the retainers was investigated using the Kaplan-Meier test, and the statistical significance was set at 0.05.

Results

There were 61 subjects at the time of recruitment, and each subject was followed up at these time points: 3, 6, and 12 months. Since it is a follow-up study, each group had some “lost to follow-up” subjects. The band-loop group had two out of 28 (7.1%) subjects lost to follow-up, the lingual arch group had four out of 18 (22.2%) subjects lost to follow-up, and the removable group had five out of 15 (33.3%) subjects lost to follow-up at three months. There was no follow-up loss in the other recall periods.

Of the 50 space maintainers, 10% failed, with 8% of these failures occurring due to ruptures or fractures in the solder between the band and loop and 2% occurring due to the partial breakage of removable appliances.

Using the Kaplan-Meier method, the mean survival time for space maintainers was estimated at 13 months. At 12 months, lingual arches had the lowest median survival time. Bands and loops and removable partial dentures had a similar probability of survival (Fig. 1).

A significant decrease in the time-dependent evaluation of the means of plaque and gingival indexes was observed. According to the plaque index values, the difference was statistically significant at the third month ($p < 0.05$), but there were no statistically significant differences at the sixth, twelfth and eighteenth months ($p > 0.05$). The gingival index values were found to be significant in terms of temporal change, although there was no difference among space maintainers at all recall times (Tables 3 and 4).

Table 3. A comparison of the changes in plaque and gingival index scores for fixed and removable appliance groups throughout the study

		N	Mean	S.s.	Min.	Max.	Between groups p	Between recall times p
Plaque index 3. month	Band_loop	26	0,82	0,096	0,00	1,67	0,018	0,000
	Lingual_arch	14	0,73	0,187	0,00	2,07		
	Removable	10	0,40	0,151	0,00	1,20		
	Overall	50	0,00	2,07	0,71	0,56		
Plaque index 6. month	Band_loop	26	0,33	0,075	0,00	1,16	0,410	
	Lingual_arch	14	0,34	0,116	0,00	1,00		
	Removable	10	0,21	0,104	0,00	0,84		
	Overall	50	0,00	1,16	0,31	0,38		
Plaque index 12. month	Band_loop	26	0,18	0,064	0,00	1,25	0,585	
	Lingual_arch	14	0,25	0,117	0,00	1,25		
	Removable	10	0,04	0,040	0,00	0,41		
	Overall	50	0,00	1,25	0,17	0,33		
Plaque index 18. month	Band_loop	8	0,13	0,123	0,00	1,00	0,074	
	Lingual_arch	1	1,00		1,00	1,00		
	Removable	5	0,00	0,000	0,00	0,00		
	Overall	14	0,00	1,00	0,14	0,36		
Gingival index 3. month	Band_loop	26	0,36	0,087	0,00	1,30	0,444	
	Lingual_arch	14	0,43	0,170	0,00	2,00		
	Removable	10	0,15	0,079	0,00	0,71		
	Overall	50	0,00	2,00	0,34	0,48		
Gingival index 6. month	Band_loop	26	0,13	0,063	0,00	1,00	0,374	
	Lingual_arch	14	0,22	0,113	0,00	1,00		
	Removable	10	0,00	0,003	0,00	0,03		
	Overall	50	0,00	1,00	0,13	0,32		
Gingival index 12. month	Band_loop	26	0,01	0,006	0,00	0,13	0,914	
	Lingual_arch	14	0,01	0,008	0,00	0,09		

Gingival index 18. month	Removable	10	0,004	0,004	0,00	0,04	0,687
	Overall	50	0,00	0,13	0,00	0,02	
	Band_loop	8	0,02	0,020	0,00	0,18	
	Lingual_arch	1	0,00	.	0,00	0,00	
	Removable	5	0,00	0,000	0,00	0,00	
	Overall	14	0,00	0,18	0,01	0,04	

Table 4. Means and Medians for Survival Time

space_maintainer	Mean				Median			
	Estimate	Std. Error	95% Confidence Interval		Estimate	Std. Error	95% Confidence Interval	
Band loop	13,476	,813	11,882	15,070	12,000	1,603	8,859	15,141
Lingual_arch	12,633	,728	11,207	14,060	12,000	,474	11,070	12,930
Removable	15,556	1,335	12,940	18,171	18,000	2,494	13,111	22,889
Overall comparison	13,724	0,560	12,627	14,821	12,000	0,791	10,450	13,550

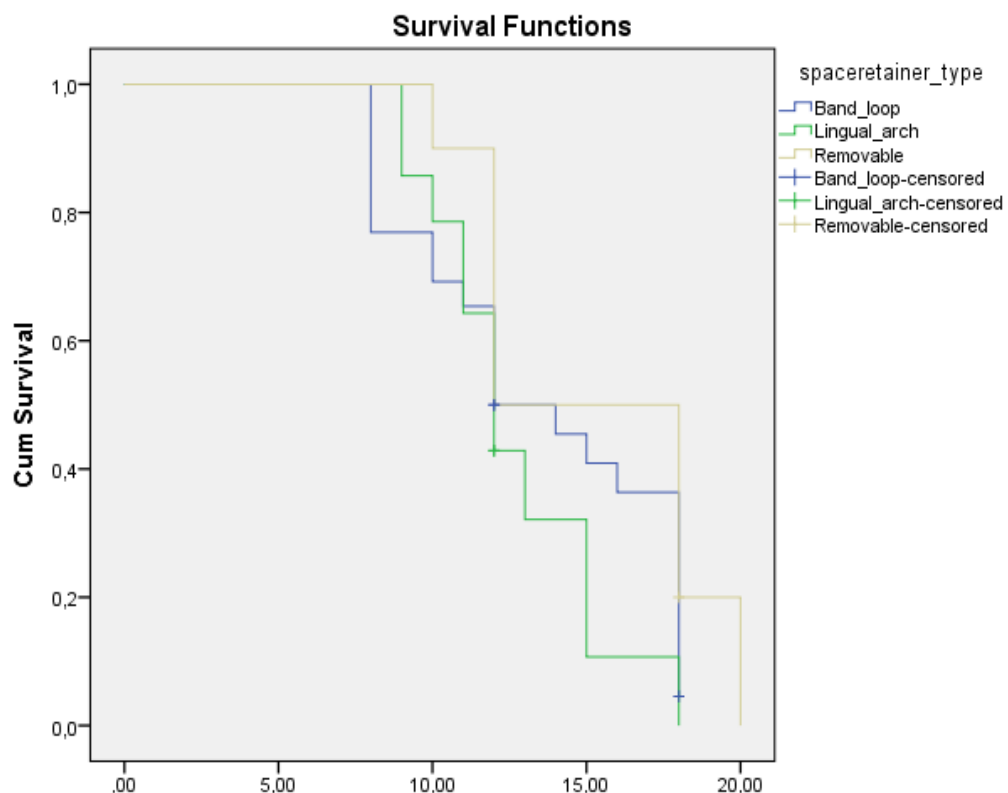


Figure 1. The cumulative survival of space maintainers related to the performance of each type of appliance

Discussion

It has been stated that fixed or removable space maintainers in the mouth increase the formation of oral biofilms as they change the surface properties and area. Many studies have reported an increase in clinical periodontal indexes such as the use of fixed or removable apparatus inside the mouth, such as caries formation, plaque index, gingival index, and pocket depth. The reason the appliances increase the formation of plaque is the contact with the gingival margins and the pressure on the soft tissue, and it has been identified as creating difficulties in practicing oral hygiene procedures (1, 2, 12). The plaque index is generally used for clinical studies and plaque control programs where plaque amount is investigated. Qualitative changes in the gingival tissue are also evaluated with the gingival index. The amount of plaque and gingival condition were evaluated using these indexes in our study (18).

In previous studies in which pediatric patients using fixed and removable appliances were followed for 6 months, plaque index, gingival index and gingival bleeding index values were significant increase was observed (6,13,15,16). These results showed similarities to our findings at 3 months recall period. As reported in our study, Arkan et al reported that there was no significant increase in time-dependent plaque index, gingival index, and gingival bleeding index values in children using removable appliances although band-loop and lingual arch space maintainers caused an increase in local plaque accumulation after 3 months of use (12). The difference between removable and fixed space maintainers may be due to the fact that the former can be easily removed during tooth brushing, which allows effective oral cleaning (16,17). Since gingival indices did not differ significantly between regions with and without removable space maintainers. Furthermore, in the present study, it is observed that there is a decrease in the average of plaque index and gingival index values at 6,12,18 recall periods. We believe that the oral hygiene training given at the beginning of the treatment and during the control appointments has been successful. In the within groups of evaluations, plaque index values were found to be different in all time intervals in terms of temporal change. When the gingival index values were evaluated in terms of time-dependent changes in the evaluations within the group, it was found to be significant at recall periods.

The survival time of the space maintainers was reported to be 11.2 months on average, considering the type of space maintainer and the age of the patient at the time of insertion (3, 9). However, the maximum survival time for a bonded space maintainer that sustained was 15.3 months (2, 3, 5). Similarly, the present study observed that survival of band loop space maintainers was 15,1 months.

In another study, the average survival of space maintainer appliances in the mouth is 7 months. It was reported that; Lingual ark showed the lowest value with 4 months; this was followed by the nance appliance (6 months), removable appliances (9

months), and the BandLoop (13 months), which remained in the mouth the most (3). These findings are in contradiction with our study. Because, in the current study, it was observed in removable appliances for the longest time, and then in lingual arch and band loop types. However, while evaluating the results, it should be kept in mind that the group with the most loss of follow-up is in the removable type. At the same time, the survival of band-loop types in the mouth may be shorter since they are used for the protection of shorter time as a result of indications for use. In our study, the average estimated duration of stay in the mouth of all space retainers was determined as 13 months. Our findings are similar to the study of Rajah et al. in which the average duration of stay in the mouth for all space maintainers is 18 months (6).

In previous studies, the failure rate of the band-loop space maintainers was reported as 29-37% (3,5,6,7). The current study stated this rate as 8%, and we attributed the difference to the different number of samples in other studies. The most common causes of failure of appliances in previous studies were reported dissolution of cement, followed by breakage of appliances, breakage in the solder area, and prevention of permanent tooth eruption. The most failure type in terms of band-loop and lingual-arch space maintainers is a breakage in the solder area in our study

Retrospective studies have strengths and weaknesses that provide direction for interpretation and future research. Pediatric dentistry literature needs long-term outcome studies of space maintainers.

Conclusions

Plaque and periodontal index scores may increase in patients using space maintainers, including fixed and removable ones. It is crucial to follow these patients closely, considering that they may be at increased risk of tooth decay and periodontal disease. They should also be informed that they should pay close attention to oral hygiene. Space maintainer treatment should be carefully planned and specific to the patient, taking into account the estimated survival time.

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