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Original Article

Comparison of the longevity of prefabricated and conventional band and loops in children's primary teeth

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ABSTRACT

Background: Prefabricated band and loops require only one appointment, are quickly placed in a session, and do not require laboratory work; thus, they need less time and cost. The aim of this study was to evaluate the survival rate of prefabricated band and loops in space maintenance of primary teeth and compare them with conventional band and loops.

Materials and Methods: In this prospective clinical trial study 4–9-year-old patients, who met the requirements of the present study, were divided into two groups. The first group conventional band and loops and the second group prefabricated band and loops were placed. The patients were evaluated for cement dissolving. Failure of soldering (SF), breakdown, and deformation of each component of the band and loops, survival rate, and gingival health at the 1st, 3rd, 6th, and 9th-month Wilcoxon test, Fisher's exact test, Mann–Whitney test, Friedman test, and Kaplan–Meier test. Was used The level of statistical significance was set at $P \leq 0.05$.

Results: The two groups were not significantly different at the 1st, 3rd, 6th, and 9th-month recalls in cement solution, SF, breakdown, and deformation of each component of the band and loops. The survival rate of the conventional and prefabricated band and loops was 92% in the 9 months, and no significant difference was witnessed in survival rates between the two groups. The prevalence of gingivitis in prefabricated band and loops and conventional band and loops in the 9th month was statistically insignificant ($P = 0.03$).

Conclusion: There is a similar success rate for the conventional and prefabricated band and loops.

Key Words: Child, primary teeth, space maintenance

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INTRODUCTION

Certainly, early loss of anterior and posterior primary teeth in children, mostly due to trauma and caries is prevalent. Loss of posterior teeth can lead to rotation, crowding, impaction of the permanent teeth, and reduced arch length, which is needed for alignment of the underlying permanent teeth. Furthermore, this may cause midline shifts in the affected side over the eruption of a front tooth and further impairment of function.[1-6]

The safest approach to prevent future malocclusion in children with premature loss of primary teeth is to put an effective, affordable, and perdurable space maintainer. The most important function of space

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maintainers is to maintain mesiodistal relations in the used dental arch. Proper use of space maintainers for keeping space until permanent teeth erupt is recommended in order not to let the space obviate and to reduce those consequences.[1,3,7,8] Since many studies have reported that space loss occurs in the first 3–6 months after tooth loss,[9-11] it is better to replace a space maintainer in the 1st month after tooth loss.[12]

Various types of appliances can be used as space maintainers, depending on children's dental developmental stage, dental arch involved, and the number of teeth involved, location, and type of primary teeth involved.[13] To prevent malocclusion that early loss of deciduous teeth causes, dentists recommend fixed or removable space maintainers. Although removable space maintainers have several advantages, such as ease of cleaning and allowing the child to observe better oral hygiene, they may not be used, get lost, worn by the patient's mouth changes, broken, or even easily destroyed. Besides if they are not used properly, they will not be effective. Among other problems of this type of space maintainers are retention and acceptability. Studies show that dentists and patients prefer well-designed fixed space maintainers to removable types.[14]

The band and loops are the most widely used fixed space maintainers in pediatric dentistry which are inexpensive and easily made. However, because of their interference with the eruption of adjacent teeth and also putting the abutment tooth at risk of caries, they require constant care. For better adaptation with dentition, these space maintainers are easily adjusted, but they neither help the mastication action nor do they prevent the eruption of the front teeth.

The band and loops are used in the following cases:

1. Unilateral loss of primary molars before or after the eruption of the first permanent molar
2. Bilateral loss of primary molars before the eruption of permanent incisors.[2,5,15,16]

Conventional band and loop space maintainers, besides having a number of failures and disadvantages, such as the dissolution of cement, failure of soldering (SF), decay on the sideline band, and time-consuming construction,[17] they also have such limitations such as:

1. Requiring at least two appointments
2. Giving the impression that they may be difficult in uncooperative children or children with a gag reflex
3. Being costly and the need for time-consuming laboratory work
4. Being sensitive to the technique employed in the procedure of different stages such as band displacement during cast pouring.

Conventional band and loops have been widely used with a high rate of success as the most practical way of space maintenance, as reported in numerous articles.[13,18,19]

In recent years, prefabricated band and loops have been presented to dentistry. They require only one appointment, are quickly placed in a session, do not require laboratory work, need less time, and are inexpensive. Some studies have reported an 84.4% success rate for them. In prefabricated space maintainers, bands are selected according to the mesiodistal width of the abutment tooth, and then, the loops are connected to the middle third of the band.[20]

The aim of this study was to evaluate the survival rate of prefabricated band and loops in space maintenance of primary teeth and compare the results with those of conventional band and loops.

MATERIALS AND METHODS

This study has been approved by resaerch and ethics committe of isfahan university of medical sciences, dental school (No:395742). This study was a prospective clinical trial. Ethical approval for conducting the study on human participants was granted from the Iranian Registry of Clinical Trials, under the IRCT registration number: IRCT2017071612848N3.

After acquiring consent from the parents of all the participants, the participants were selected from among all the 4–9-year-old patients who appeared in the Department of Pediatric Dentistry of the Isfahan University of Medical Science in 2016. The selected participants had the following features: a preextracted or lost primary first molar in any of the arches, an extraction site with no space loss, a decayed second primary molar adjacent to a lost first primary molar that needed pulpotomy and crown, presence of a replacement permanent tooth bud, absence of a root furcation involvement in the abutment tooth, absence of abscesses and tooth mobility in the abutment tooth, adequate bone coverage that indicated >6 months remained until the permanent tooth erupted, and good oral hygiene.

A brief history was recorded for each participant, and clinical examinations were done. Intraoral periapical radiographs were taken in the areas of tooth loss. For every selected participant, an oral prophylaxis was done before the placement of a space maintainer.

From a total of 50 children who were finally selected to participate in the study, 50 extraction sites comprised the sample. They were then divided into two groups by computer randomization according to their file number [Table 1]. In both groups, the posterior abutment molar required a crown restoration due to decay and pulp involvement. A clinician performed caries removal, formocresol pulpotomy, filled the pulp chamber with IRM (Dentsply Caulk, Milford, DE, USA), removed and prepared the crown, and then selected and fitted an appropriate stainless steel crown (3M, Minnesota, USA). Then, she performed crimping and cementation of crowns (with GC Fuji, Tokyo, Japan) and placed a space maintainer in the arch with an extraction site. For each space maintainer in the two groups of conventional and prefabricated band and loops, the pediatric dentist followed the same steps, using the same dental materials.

The application technique of conventional band and loops (Group I)

For each band and loop (B&L) space maintainer, the smallest stainless steel band (3M, Minnesota, USA) that fitted was selected. Impressions were taken with alginate material, stabilizing the band with a drop of super glue in the impression material. Impressions were poured up using dental stone within 30 min of the impression taking. The loops were prepared using 0.036-inchSteel wires, and flux (Dentaurum Universal Dentflux). The same technician performed laboratory work for all the study space maintainers. Seven days later, the children were given an appointment for space maintainer checking and cementation. Cotton roll isolation was used, cementation was performed with GC Fuji (Tokyo, Japan), and the participants were instructed not to eat for 30 min following their cementation. Parents were given postcementation care advice and were instructed to contact the clinic in case they had any complaints. Follow-up appointments were scheduled at 1, 3, 6, and 9 months.

The application technique of prefabricated bands and loops (Group II)

For each patient, a prefabricated band (MIB, Paris, France) was selected for the abutment tooth by measuring the mesiodistal diameter of the abutment tooth with a caliper and was adjusted with the internal diameter of the prefabricated band. It was ensured that it covered the entire surface of the tooth. The loop was selected based on the available mesiodistal space and buccolingual width of the abutment tooth and was then placed inside the band's tube by using a HOW pliers (3M, ESPE, USA). After checking the cementation, which was performed with GC Fuji (Tokyo, Japan), each patient was instructed not to eat or drink for 30 min and not to bite any hard food. Parents were given postcementation care advice and were instructed to contact the clinic in case they had any complaints. Follow-up appointments were scheduled at 1, 3, 6, and 9 months.

Instructions for oral hygiene and appliance maintenance were given to children in front of their parents. Patients were recalled at 1-, 3-, 6-, and 9-month intervals for evaluation of space maintainers using the checklist presented in Table 2.

Survival rate

The survival rate was checked based on the following checklist:

a. Cement solution (CS)
b. SF
c. Breakdown and deformation of individual components of band and loops (BD).

By observing every item in the above checklist in follow-up recalls, the decision was made whether to

Table 1: Distribution of the participants in the sample Groups I and II

Groups	Space maintainer used	Sample size
I	Conventional band and loop	25
II	Prefabricated band and loop	25

Table 2: Evaluation checklist

	Inspection method	Rating
Cement solution	Visual inspection with explorer and mirror	Absent Present
Failure of soldering	Visual inspection with explorer and mirror	Absent Present
Breakdown and deformation of each component of band and loops	Visual inspection with explorer and mirror	Absent Present
Gingival health	Visual inspection with blunt periodontal explorer and mirror	Normal Mild gingivitis Moderate gingivitis Severe gingivitis
Survival rate	Visual inspection	Failed Successful

call the band and loop a failure (F) to be excluded for further evaluation in the study; however, the patient's problem would be resolved, anyway.

In case all the items in the checklist were absent in follow-up recalls, we called the band and loop a success (S).

Gingival health

The gingival health was checked by the Gingival Index described by Silness and Loe.[21]

The results obtained were then tabulated accordingly and checked for statistical significance.

The data collected in 1-, 3-, 6-, and 9-month intervals were then tabulated and statistically analyzed using the Wilcoxon test, Fisher's exact test, Mann–Whitney test, Friedman test, and Kaplan–Meier test. All the statistical operations were performed, using SPSS version (17.0). The level of statistical significance was set at $P \leq 0.05$.

RESULTS

There were 25 participants in each of the two groups at the time of recruitment, and each participant was followed up at four-time points, i.e., 1, 3, 6, and 9 months. There was no follow-up loss in the two groups, and both groups had a 100% follow-up in the 1st, 3rd, 6th, and 9th months.

Conventional band and loops showed one case of CS in the 6th-month follow-up. Fisher's exact test showed no statistically significant difference in the CS between the two groups in the 6th-month follow-up ($P = 0.99$), and also, conventional band and loops showed one case of a band and loop component deformation in the 9th month. Prefabricated band and loops showed one case of loop fracture in the 6th month and one case of a band and loop component deformation in the 9th month. Fisher's exact test showed no statistically significant difference in the breakdown and deformation of the component of the band and loops between the two groups in the 6th-month follow-up ($P = 0.99$) [Table 3].

Prefabricated band and loops showed the same survival rate at the end of the 9th-month follow-ups in both conventional and prefabricated band and loops. Survival analysis with Kaplan–Meier test showed no statistically significant difference between survival rate between the two groups at the 9th month ($P = 0.99$) [Table 4].

Gingival health was observed at 1-, 3-, 6-, and 9-month intervals. The Mann–Whitney test showed no statistically significant difference between the gingival health of the two groups in the 1st, 3rd, and 6th-month follow-ups ($P = 0.225$), ($P = 0.739$), and ($P = 0.117$). Prefabricated band and loops revealed more gingival health in the 9th-month follow-up, and Mann–Whitney test showed a statistically significant difference between the gingival health of the two groups in the 9th-month follow-up ($P = 0.03$) [Table 5].

Gingival health in the conventional band and loops

The Friedman test showed no statistically significant difference between the gingival health of the four different follow-up times in the conventional band and loop group ($P = 0.873$).

Gingival health in the prefabricated band and loops

The Friedman test showed a statistically significant difference between the gingival health of the four different follow-up times in the prefabricated band

Table 3: Comparison of cement solution, failure of soldering, breakdown, and deformation of individual components of band and loops between the two groups

Variable	Type of band and loop	1st month, *n* (%)	3rd month, *n* (%)	6th month, *n* (%)	9th month, *n* (%)
Failure of soldering	Conventional band and loop	0	0	0	0
	Prefabricated band and loop	0	0	0	0
Cement solution	Conventional band and loop	0	0	1 (4)	0
	Prefabricated band and loop	0	0	0	0
Breakdown and deformation	Conventional band and loop	0	0	0	1 (4)
	Prefabricated band and loop	0	0	1 (4)	1 (4)

Table 4: Comparison of survival rate between the two groups

Type of band and loop	1st month, *n* (%)	3rd month, *n* (%)	6th month, *n* (%)	9th month, *n* (%)
Conventional band and loop	25 (100)	25 (100)	24 (96)	23 (92)
Prefabricated band and loop	25 (100)	25 (100)	24 (96)	23 (92)

Table 5: Comparison of gingival health between the two groups

Type of band and loop	Follow-up sessions	Normal gingiva, *n* (%)	Mild gingivitis, *n* (%)	Moderate gingivitis, *n* (%)	Severe gingivitis, *n* (%)
Conventional band and loop	1st month	8 (32)	13 (52)	4 (16)	0
	3rd month	8 (32)	14 (56)	3 (12)	0
	6th month	8 (32)	12 (48)	5 (20)	0
	9th month	7 (29.2)	13 (54.3)	4 (16.6)	0
Prefabricated band and loop	1st month	5 (20)	13 (52)	7 (28)	0
	3rd month	7 (28)	18 (72)	0	0
	6th month	11 (44)	14 (56)	0	0
	9th month	14 (58.3)	9 (37.5)	1 (4.2)	0

and loops ($P < 0.001$); in addition, Wilcoxon test showed a statistically significant difference between the gingival health of the 1st and 3rd, 1st and 6th, 1st and 9th, 3rd and 6th, and 3rd and 9th follow-ups ($P = 0/007$), ($P < 0/001$), ($P = 0/001$), ($P = 0/46$), and ($P = 0/02$), respectively.

Furthermore, the Wilcoxon test showed no statistically significant difference in their gingival health between the 6th and 9th months ($P = 0/18$).

DISCUSSION

The results of our study showed that during the 1st, 3rd, 6th, and 9th months, no solder breakage was observed in the two study groups, and there was no significant difference between the two types of space maintainers in terms of solder defect.

Furthermore, the results during the 1st, 3rd, 6th, and 9th months of the follow-ups showed no dissolution of the cement in the prefabricated band and loops. Besides in the conventional band and loop group, there was no case of cement dissolution in the 1st, 3rd, and 9th months.

In the prefabricated group, no cases of fracture or deformation of the band and loops were observed in the 1st and 3rd months, and as for the failure and deformation of the components of the band and loop, no significant difference was observed between the two groups.

In terms of survival rates, both groups had a survival rate of 100% in the 1st and 3rd months, with a decrease to 96% in both groups in the 6th month and 92% in the 9th month.

In the study of Sami Malik *et al.*,[22] the most common cause of broken band and loops in a duration of 12 months was loop fracture and cement dissolution, and the success rate was 86.6%.

In a study by Sasa *et al.*,[23] the success rate of conventional band and loops in a 20-month study was 40%, from among which 82% of the failures related to the solvent cement.

Our results showed that there was no significant difference between the two types of band and loops in terms of durability. Due to the cost and time of the conventional type and the need for multiple sessions and molding, the prefabricated band and loop type is less time-consuming for both the dentist and the patient and also more cost-effective for the patient.

In the Setia *et al.*'s[20] 3-month studies in India, the success of prefabricated band and loops was 92.3%, whereas it was 86.7% of the conventional types. Furthermore, the success rate of prefabricated band and loops in the 6th and 9th months was 84.6%, and in the conventional type, it was 80%, whereas in the 9th month, it was 73.3%. The findings of the present study also indicate that the success rate of the prefabricated band and loops is more than conventional types. Considering the advantages of the prefabricated kind, it is more rational to expect them to be used more frequently in the future.

Moreover, due to the low success rate of 45.5% of the band and loop with fiber-reinforced composites (FRCs) over a 9-month period, according to the results of Setia *et al.*'s study,[20] as well as the low success rate of 43% of FRC in Kargul *et al.*'s[3] 12-month study, and the disadvantages of composite detachment from the base of the tooth surface, using the prefabricated type appears to be more logical.

The results of the present study on gum health, based on the Gingival Index, indicate that there was no significant difference between the conventional band and loop and the prefabricated groups in the 1st, 3rd, and 6th months of the study, as relates to the presence of gingivitis.

However, in the 9th month, the situation was different; 13 cases of mild and 4 cases of moderate gingivitis were reported for the conventional type; whereas, only 9 cases of mild and 1 case of moderate gingivitis were reported for the prefabricated type. The results show that there was a significant difference ($P = 0.03$) between the gingivitis rate among the two groups in the 9th month of the study; there were fewer gingivitis cases in the prefabricated band and loop group.

The comparison of gingivitis in the conventional group at different times did not show any significant difference, but it showed that gingivitis in the prefabricated type was more moderate in the 1st month than in the 3rd, 6th, and 9th months.

Based on these findings, the cause of more frequent incidence of moderate gingivitis in the 1st month compared to the other months in the prefabricated type seems to have been the immediate cementation of the band and loop after tooth extraction and insertion of stainless steel crown on the abutment tooth in the same session; the gum did not have enough time for healing. However, in the conventional type, due to the opportunity for healing, gingivitis in the 1st month was less frequent than in the prefabricated type, but no difference was seen in the other months.

In Setia *et al.*'s[20] study, prefabricated band and loops showed high levels of gum health (72.8% within 9 months), in comparison with the conventional type (45.7% within 9 months). This implies that the prefabricated type is more compatible with the gum, and therefore, less inflammation will accrue in the gum tissue.

CONCLUSION

Comparison of the success rates of the prefabricated and conventional band and loops, as relates to gum health as well as dental office work, revealed that the use of the prefabricated band and loops is more rational and cost-effective than the conventional ones.

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Conflicts of interest

The authors of this manuscript declare that they have no conflicts of interest, real or perceived, financial or nonfinancial in this article.

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