**Introduction**

The primary dentition plays a very important role in child growth and development not only in terms of speech, chewing, appearance, and the prevention of bad habits but also in the guidance and eruption of permanent teeth. The premature loss of primary teeth is one such condition that can affect the status of neutral occlusion in the permanent dentition, which can lead to undesirable mesial and distal movements of primary and permanent teeth, resulting in loss of the arch length.

The safest approach to maintain arch space and to prevent future malocclusion is to place a space maintainer. The greatest amount of tooth displacement occurs within 6 months following the loss of teeth, so it is best to insert a space maintainer just after the loss of teeth.

The space maintainers are broadly classified as removable and fixed types which are further classified as banded and bonded, active and passive, functional and nonfunctional.

Of the various fixed space maintainers, the band and loop space maintainers are one of the most frequently used appliances, but it has various shortcomings that may be overcome through the use of directly bonded space maintainers such as fiber-reinforced composite resins (FRCR) as fixed space maintainers. The most popular fiber types are glass fibers and ultra-high molecular weight polyethylene fibers. Majority of studies have been conducted using bonded space maintainers by bonding both buccal and lingual side of abutment teeth and comparing the results with band and loop space maintainer. The present clinical study was conducted to check the efficacy of bonded space maintainers by bonding only buccal aspects of abutment teeth and comparing this with conventional band and loop space maintainer.

**Banded versus Single-Sided Bonded Space Maintainers: A Comparative Study**

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**Abstract**

**Background:** The present study is conducted to evaluate and compare the clinical performance of conventional band and loop space maintainer and fiber reinforced composite resin (FRCR) space maintainers. **Materials and Methods:** A total of 45 extraction sites in the age group of 6–9 years having premature loss of primary molars or indicated for extraction were selected for the study. The patients were randomly divided into three groups as Group I, in which conventional band and loop space maintainer was given, Group II and Group III (FRCR), in which FRCR (everStick CandB) and impregnated glass fibers (Interlig) space maintainers were given, respectively. Patients were recalled at 3, 6, and 12-month interval for evaluation of all the three types of space maintainer. **Results:** Overall success rate of Group I was 86.7%, for Group II was 80%, and for Group III was 73.3% at the end of the study. Patient acceptability was significantly higher in Group II and Group III (FRCR) as compared to Group I (Conventional band and loop). In Group I, cement loss and fracture of loop, whereas in Group II and Group III, debonding at enamel composite was the most common failure followed by debonding at fiber composite and fiber fracture. FRCR space maintainers were found to be cost-effective as compared to Group I. More linear changes and angular changes were recorded in Group I as compared to Group II and Group III but difference was not significant ($P > 0.05$). **Conclusion:** Only single (buccal) surface application of FRCR space maintainers showed almost equal clinical efficacy compared to conventional band and loop space maintainer with significantly better patient acceptability, less cost, and time taken.

**Keywords:** Conventional band and loop, fiber reinforced composite resin, space loss, space maintainers

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**MATERIALS AND METHODS**

The present clinical study was conducted on children of age group 6–9 years visiting the Department of Pedodontics and Preventive Dentistry. The patients with premature loss of primary molars or indicated for extraction were selected for the study. The ethical approval for the study was taken from the ethical committee of the institution, and written consent from the parents of the patients was obtained.

The total 45 extraction sites having premature loss of deciduous teeth were selected having the following inclusion criteria such as caries free abutments teeth, teeth present on mesial and distal side of extraction space, absence of abnormal dental conditions such as crossbite, openbite, deep bite, and adequate bone overlying erupting successor on the radiographic examination. The exclusion criteria include absence of teeth on mesial and distal side of edentulous area, patient with a history of systemic diseases, radiographic examination, and patient with furcal pathosis or cariously involved nonrestorable abutment teeth. Oral prophylaxis and other restorative treatments were done before the placement of space maintainers and the study models of all the patients were made. The patients were divided into three groups. In Group I, conventional band and loop were given, Group II Glass FRCR (everStick C and B, GC Europe) and Group III Impregnated glass fibers (interlig, Angelus Londrina Brasil) was given, and the patients were recalled at 3, 6, and 12-month interval for follow-up.

The fabrication of the conventional band and loop was done by the method given by Graber\(^7\) and Finn.\(^8\) Space maintainer was cemented using luting glass-ionomer cements (type I) [Figure 1].

The amount of FRCR to be placed was measured using digital vernier caliper (PRECISION). Buccal surface of both the abutment teeth were cleaned with pumice slurry, isolated with rubber dam and were etched with 37% orthophosphoric acid (N-etch, Ivoclar, Vivadent India) for 60 s, washed and dried, followed by application of bonding agent (Tetric-N Bond, Ivoclar) which then was cured for 20 s. A thin layer of flowable composite Genial Universal Flo (GC Corporation Tokyo, Japan) was applied on the buccal surface of abutment tooth, and the measured length of FRCR was placed on this composite, extending from buccal aspect of mesial abutment to buccal aspect of distal abutment tooth. The ends of fiber were adapted to the teeth surfaces with a plastic filling instrument. Preliminary curing was done individually at each end of the fiber framework for 5–10 s. An additional layer of flowable composite was applied over the entire fiber frame, and this was light-cured for 40 s. The space maintainer was checked for any occlusal and gingival interference. Finishing was done with composite finishing burs [Figures 2 and 3].

Instructions on oral hygiene and appliance maintenance were given to both children and parents. Patients were recalled at 3, 6, and 12 months interval for the evaluation of space maintainers using the following criteria:

Clinical evaluation of the patient was carried out to check for patient acceptability, distortion, cement loss, fracture
of the loop, caries and loss of space (tipping/rotation), and
cost-effectiveness in Group I and in Group II and Group III
patient acceptability, debonding at the enamel-composite
interface, debonding at the fiber-composite interface, fracture
of the fiber frame, caries, loss of space (tipping/rotation),
cost-effectiveness at 3, 6, and 12 months recall.

Patient acceptability toward treatment was checked using
visual analog scale (six-point facial Wong–Baker Scale) after
the treatment completion [Figure 4].

**Measurements**
The ability of the space maintainer to maintain the space during
the study was determined by evaluating the linear and spatial
relationships between the two abutment teeth using modifying
the method of Swaine and Wright[9] and calculated by entering
the data into Microsoft Excel software. The measurements
were calculated on the initial study models before applying
the space maintainers, and then after placement of space
maintainers at 3, 6, and 12 months interval using digital vernier
calliper [Figure 5].

The measurements and calculations were made in the following
way.

**Measurements done when deciduous first molar is
missing**
1. In the absence of primary first molar, mesiobuccal and
   mesiolingual cusp tips of the primary second molar, and
   the cusp tip of the canine formed the three points which
   were joined to form a triangle with the corresponding
   sides as A1, B1, and C1 as shown in [Figure 6]. In the
   absence of primary first molar, the line that connects the
   mesiobuccal and mesiolingual cusp tips of the primary
   second molar constituted the base side (A1) of the
   triangle
2. The line that connects the mesiobuccal cusp tip of the
   primary second molar and the cusp tip of the canine forms
   the second side (B1) of the triangle
3. The line that connects the mesiolingual cusp tip of the
   primary second molar and the cusp tip of the canine
   formed the third side (C1) of the triangle.

The measurements recorded under these criteria were applied
in square root formula

\[(B1 \times B1 + C1 \times C1 - A1 \times A1/2)/2\] Thus, the linear changes
were obtained.

To find out whether there any rotating movement occurred
in the abutment teeth, the apex angle of the triangle was
taken into consideration. This angle was calculated with the
degree formula \((\text{ACOS} (B1 \times B1 + C1 \times C1-A1 \times A1)/
[2 \times B1 \times C1])\).

**Measurements done when deciduous second molar is
missing**
In the absence of the primary second molar, mesiolingual and
mesiobuccal cusp tips of the first permanent molar distolingual
and distobuccal cusp tips of the primary first molar tooth
formed the four points of the rectangle with the corresponding
sides been A1, B1, C1, D1 which were then measured and
recorded [Figure 7].

Afterward, the length of the line that connects the midpoints of
the lines connecting the cusp tip of each tooth was calculated through
the square root formula \((B1 \times B1 + C1 \times C1- (A1 - D1)
\times (A1 - D1)/2)/2\) and linear changes were obtained. To
determine if any angular change occurred in the space
maintainers bonded to abutment teeth the apex angle of the
triangle was obtained through the connection of the
line (E1) extending from the mesiolingual cusp tip of the first permanent tooth to the distobuccal cusp tip of the primary first molar. To calculate the angle the degree formula was used ([ACOS (B1 × B1 + E1 × E1 − A1 × A1)]/[2 × B1 × E1]).

**Results**

The data thus obtained was tabulated and subjected to statistical analysis using SPSS 22.0. Chi-square test and Kruskal–Wallis test were done to know the effect of each variable and to reveal the statistical significance. The *P* < 0.05 was considered to be statistically significant. At the start of the study, there were 15 participants in each group. The participants were followed at 3, 6, and 12 months interval.

At 3-month follow-up overall success for Group I was 93.4%, Group II was 86.7%, and Group III was 86.7%. In Group I, the initial failure (6.7%) was due to cement loss. Group II and III showed 13.4% of failures due to debonding at enamel composite surface.

At 6-month recall overall success was 86.7% for Group I, there was 6.7% of failure due to solder failure at 6-month recall. Group II showed 80% success another failure was due to debonding at the enamel–composite interface (6.7%). Group III showed 80% success, failure seen was due to debonding at the fiber–composite interface (6.7%).

At 12-month follow-up, overall success for Group I was 86.6%, for Group II 80%, and for Group III 73.3%. On overall comparative analysis, there was statistically no significant difference in retention between these three types of space maintainers second molar [Table 4].

**Discussion**

The normal process of exfoliation of the primary teeth and eruption of permanent teeth is disrupted due to premature loss of primary tooth/teeth. A series of changes are observed in dental arches resulting in malocclusion. To combat this problem, a number of space maintainers have been designed which can either be a removable or a fixed; functional or nonfunctional; and unilateral or bilateral. The selection can be made depending on the need of the situation.

Of all the fixed space maintainers used in pediatric dentistry, the band and loop ones are the most prevalent and have demonstrated high success rates in the past. However, there are disadvantages such as tendency for disintegration of the cement, inability to prevent the rotation and tipping.

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**Table 1: Percentage of failure in group I, II and III**

|                      | Group I, n (%) | Group II, n (%) | Group III, n (%) | *χ²* | *P* |
|----------------------|---------------|----------------|-----------------|------|-----|
| Distortion/debonding at enamel composite interface |               |                |                 |      |     |
| Preoperative         | 0             | 0              | 0               | -    | -   |
| 3 months             | 0             | 1 (6.7)        | 1 (6.7)         | 1.047| 0.593|
| 6 months             | 0             | 1 (6.7)        | 1 (6.7)         | 1.047| 0.593|
| 12 months            | 0             | 0              | 0               | -    | -   |
| Cement loss/debonding at fibre composite interface |               |                |                 |      |     |
| Preoperative         | 0             | 0              | 0               | -    | -   |
| 3 months             | 1 (6.7)       | 0              | 0               | 1.047| 0.593|
| 6 months             | 0             | 0              | 1 (6.7)         | 1.047| 0.593|
| 12 months            | 0             | 0              | 0               | -    | -   |
| Fracture loop/fracture fibre framework |               |                |                 |      |     |
| Preoperative         | 0             | 0              | 0               | -    | -   |
| 3 months             | 0             | 0              | 0               | -    | -   |
| 6 months             | 1 (6.7)       | 0              | 0               | 1.047| 0.593|
| 12 months            | 0             | 0              | 1 (6.7)         | 1.047| 0.593|

In Group I, more linear and angular changes between primary to primary and primary to permanent abutment teeth were recorded as compared to Group II and Group III at the end of the study. On intergroup comparison, when Group I was compared with other two groups, no statistically significant difference was found with (*P* > 0.05) [Table 3].

At 12-month follow-up, overall success for Group I was 86.6%, for Group II 80%, and for Group III 73.3%. On overall comparative analysis, there was statistically no significant difference in retention between these three types of space maintainers second molar [Table 4].

Patient acceptability was higher in Group II and Group III as compared to Group I, with statistically significant difference (*P* < 0.05) at all stages of follow-up [Table 2 and Figure 4].
movement of abutment teeth, a tendency to get embedded in gingival tissues or for promoting caries formation, the need for a cast or model, the need for a second visit, and increased chairside and laboratory time.[16]

Development of fiber reinforced composite technology has brought a new material into the realm of metal-free, adhesive esthetic dentistry, and it can be used as an alternative to the conventional space maintainer.[17] EverStick (GC group, Europe) used in this study is translucent-colored and semi-manufactured product. It consists of 4000 individually silanated E-Glass fibers that are fully impregnated with bisphenol A-glycidyl methacrylate (BIS-GMA) and polymethyl methacrylate acrylic to form the strong, esthetic, and durable interpenetrating polymer network.[16,18,19] Interlig by Angelus, Brazil is a braided, intertwined glass fiber impregnated with dental resin BIS-GMA.[20]

Children between the age group of 6–9 years were selected for the study because in most of these children, the first permanent molars had not yet completely erupted into the oral cavity and thus they could not be banded. Furthermore, many children did not have all their mandibular permanent incisors erupted so not possible to give a fixed lingual arch.

To improve the retention of the glass FRCR space maintainer, different designs and materials have been used.[15,16,18] In an earlier study done by Kargul et al.[18] and Setia et al.,[21] fiber is only bonded to natural tooth in the form of bridge. Thus, the hanging fiber bridge is subjected to compressive and tangential forces that might lead to fracture of fiber frame. Second, the transmission of forces from fiber frame to bonding margins between tooth and fiber on either side of framework might have weakened the bond and would have caused debonding of fiber composite interface or enamel cement interface. Kirzioglu (2004)[2] applied on lingual surface to minimize the occlusal forces acting on it. However, there was a high failure rate (67%–94%).[4]

In this study, improvised design of fiber which was placed only on the buccal aspect of the abutment teeth provided adequate surface area for firm bonding and micromechanical retention.

### Table 2: Percentage of treatment acceptance

| Acceptance level | Group I ($n=15$), $n$ (%) | Group II ($n=15$), $n$ (%) | Group III ($n=15$), $n$ (%) |
|------------------|---------------------------|-----------------------------|-----------------------------|
| No hurt          | 0                         | 14 (93.3)                   | 13 (66.6)                   |
| Hurts little bit | 0                         | 1 (6.7)                     | 1 (6.7)                     |
| Hurts little more| 1 (6.7)                   | 0                           | 0                           |
| Hurts even more  | 10 (66.6)                 | 0                           | 0                           |
| Hurts whole lot  | 3 (2)                     | 0                           | 0                           |
| Hurts worst      | 1 (6.7)                   | 0                           | 0                           |
| -                | 6.53±1.4075               | 0.13±0.5164                 | 0.33±0.8997                 |
| Hurts even more  | No hurt                   | No hurt                     | No hurt                     |

$\chi^2=38.031; P<0.001$. [using visual analog scale, Figure 4]

### Table 3: Linear and angular changes at recall

|                          | Group I (control) | Group II (experimental group) | Group III (experimental group) |
|--------------------------|-------------------|-------------------------------|--------------------------------|
| Mean±SD                  |                   |                               |                                |
| **Linear changes when deciduous first molar is missing** |                   |                               |                                |
| Preoperative             | 220.58±126.596    | 159.77±26.623                 | 171.01±12.390                 |
| 3 months                 | 203.09±108.011    | 158.52±26.392                 | 169.52±14.048                 |
| 6 months                 | 207.76±110.410    | 154.16±26.832                 | 166.94±22.151                 |
| 12 months                | 201.26±104.306    | 150.36±24.329                 | 169.97±14.281                 |
| **Linear changes when deciduous second molar is missing** |                   |                               |                                |
| Preoperative             | 137.38±52.317     | 133.69±11.203                 | 140.90±13.231                 |
| 3 months                 | 133.60±49.610     | 135.65±10.338                 | 142.91±12.994                 |
| 6 months                 | 123.18±5.346      | 138.00±0.000                  | 141.46±2.073                  |
| 12 months                | 100.89±0.000      | 135.91±28.249                 | 140.91±3.630                  |
| **Angular changes when deciduous first molar is missing** |                   |                               |                                |
| Preoperative             | 0.28±0.163        | 0.37±0.0436                   | 0.35±0.031                    |
| 3 months                 | 0.35±0.072        | 0.37±0.0431                   | 0.36±0.032                    |
| 6 months                 | 0.35±0.075        | 0.38±0.050                    | 0.36±0.039                    |
| 12 months                | 0.34±0.068        | 0.38±0.053                    | 0.35±0.029                    |
| **Angular changes when deciduous second molar is missing** |                   |                               |                                |
| Preoperative             | 0.40±0.086        | 0.36±0.063                    | 0.41±0.038                    |
| 3 months                 | 0.41±0.078        | 0.37±0.053                    | 0.41±0.036                    |
| 6 months                 | 0.41±0.058        | 0.37±0.061                    | 0.41±0.036                    |
| 12 months                | 0.43±0.073        | 0.38±0.055                    | 0.40±0.035                    |

$\chi^2$ and $P$ values for statistical significance.

SD: Standard deviation
Since space maintainers were placed only on single side (buccal aspect), there was no irritation for the tongue, ample clearance between the fiber frame, and the underlying tissue thus likely to permit better oral hygiene maintenance, causes no trauma to the gingival tissue and better patient compliance. All FRCR space maintainers in this study were applied under rubber dam isolation and the use of high-volume suction.

Clinical efficacy of all the three types of space maintainers was evaluated by various criteria's at 3rd, 6th, and 12th months. During this period, if failure had occurred space maintainers were either repaired or replaced; these cases were not considered further in the study.

The results of this study revealed the significant difference toward acceptability of space maintainer within three groups.

In Group I, patient’s repetitive band adaptation procedure and impression making were difficult in young and uncooperative children or those with severe gag reflex led to its poor acceptability. Our results are in accordance to the study done by Nayak et al., which inferred that band and loop require minimum two appointments with more laboratory time and difficulty in impression making in young and uncooperative child.

In Group II and Group III since space maintainers were applied only on the buccal surface of the abutment teeth, were easy to apply require single visit without hurting the patients, less bulky, covers less space in the oral cavity making them feel natural, and meets patients esthetic expectations provided better patient compliance. The results are according to the study done by Kargul et al.,[19] concluded that FRCR space maintainers do not make any contact with adjacent periodontal tissues, thereby eliminating periodontal problems affiliated with conventional fixed space maintainers and patient acceptability was greater in FRCR in comparison to band and loop space maintainer.

Our results are also according to study done by Garg et al.[21] and Goenka et al.,[24] who concluded that patient acceptability was greater in FRCR in comparison to band and loop space maintainer.

In this study, one failure in Group I was due to cement loss at 3-month recall and one failure was due to fracture of loop (solder breakage) at 6-month recall. Failure due to cement loss could be due to improper isolation during cementation, especially in young patients or it may attributed to poor band fit.[20] Furthermore, the mechanical bonding between the band material and the luting cement is less strong than the combined mechanical and chemical adhesion of glass ionomer to tooth enamel. Failures due to solder breakage (fracture of loop) may be due to an incomplete solder joint.[25,26]

Our results are in accordance with the results of Qudeimat et al.[16] Baroni et al.,[13] Moore and Kennedy,[10] and Subramaniam et al.,[16] who observed that most common cause of failure of space maintainer was cement loss. In another study by Rajab,[14] solder breakage was the most common cause of failure and the second most common cause was cement loss.[25]

Failures observed in Group II and Group III was maximum due to debonding of enamel–composite interface. The failure due to debonding at enamel composite interface continued till 6-month follow-up. One of the reasons attributed to failure for debonding at enamel composite interface in Group II and Group III was that the children selected for the study was schoolgoing age and mostly having a habit of putting pencils inside the mouth, so they pulled out the fiber framework. Other cause to the debonding of enamel–composite in FRCR space maintainers may be attributed to its placement on primary teeth (both abutment teeth), the presence of prismless enamel which has poor bond strength with resins.[15,28]

The result of this study is in accordance with the studies done by Kirzioglu and Ozay,[2] Kargul et al.,[19] and Subramaniam et al.,[16] who found the main cause of failure of space maintainers were due to debonding at the enamel composite interface.

Our results are contrary to study done by Kirzioglu and Ozay,[2] which reported failure of varying rates (67%–94%) of space maintainer, but they attributed it to nonapplication of rubber dam.[23] The difference in the failure rate in this study might be due to the use of rubber dam in this study.

One case showed the failure due to fracture of fiber frame in Group III at 12th-month recall was due to supraeruption of the opposing tooth and its impingement on the fiber frame which has become functional resulting in increased amount of mechanical stresses on the fiber framework and its subsequent fracture.[20]

The majority of space maintainers that dislodged were found in the mandible, it may be attributed to the excess of chewing forces in the mandible. Artun and Marstrander[29] in 1983 stated that occlusal trauma might be more of a problem in the mandible.

None of the patients developed caries in all the three groups throughout our study over the period of 12 months. No caries incidence was due to complete flushing of the material from the abutment tooth with no additional food retentive areas leads to maintenance of good oral hygiene and consequently no development of caries. Moreover, band and loop were removed every 6 months for the fluoride application. Our results are in accordance with the study conducted by Kirzioglu and Ozay,[2] Subramaniam et al.[16] and Setia et al.,[21] who observed no carious lesion in their study.

### Table 4: Comparative evaluation at 3, 6 and 12 months

| Evaluation period | Group I \( (n=15) \), \( n \) (%) | Group II \( (n=15) \), \( n \) (%) | Group III \( (n=15) \), \( n \) (%) | \( P \) |
|-------------------|-------------------------------|-------------------------------|-------------------------------|------|
| At 3 months      | 14 (93.3)                     | 13 (86.7)                     | 13 (86.7)                     | 0.799 |
| At 6 months      | 13 (86.7)                     | 12 (80)                       | 12 (80)                       | 0.431 |
| At 12 months     | 13 (86.7)                     | 12 (80)                       | 11 (73.3)                     | 0.407 |
Group I was found to be more expensive as compared to Group II and Group III in terms of cost-effectiveness to the patients at the end of the study. In Group I, the fabrication of space maintainer required more laboratory time, and the procedure was completed in two appointments. Nayak et al.,[22] Kargul et al.,[19] and Kulkarni et al.,[26] inferred that fabrication of conventional band and loop space maintainer required more laboratory time and needed minimum of two appointments. They concluded that this procedure was time taking and labor intensive, therefore, expensive. McDonald and Avery[26] suggested that the band and loops should be removed once a year to inspect, clean, and apply fluoride to the tooth.

In Group II and Group III, the space maintainers was applied on single side (buccal aspect), less chairside time was required and was completed in single appointment. FRCR eliminates the annual steps of maintenance, so charged less to the patients. Our results are in accordance to the study done by Artun and Marstrander,[29] Kargul et al.,[19] Yeluri and Munshi,[30] Goenka et al.[24] who concluded that bonded space maintainers are single-visit procedure, saving cost and chair time, and needs no cooperation.

Our results are contrary to Adlakha et al.[31] they concluded in their case report that FRCR space maintainers are relatively costly.

In Group I, more linear and angular changes between primary-primary abutment teeth and between primary-permanent abutment teeth was found at 3, 6, and 12 months interval then Group II and Group III, but these changes showed no statistical significant difference when Group I was compared with Group II and Group III.

The more loss of space in Group I, which appeared in the linear and angular measurements between the abutment teeth might be due to point contact of band and loop on unattached abutment tooth which loses the proper contact leads to tipping and rotation of abutment teeth. Comparative lesser loss of space in Group II and Group III, which appeared in the linear measurements between the abutment teeth may be attributed to surface adaptation of FRCR space maintainers which makes the firm contact with both the abutment teeth.

Our results are in accordance with the results of the studies conducted by Swaine and Wright,[9] Simsek et al.,[11] and Yilmaz et al.[32] which showed that loss of space which might appear in the linear and angular measurements between the abutment teeth was no statistical significant difference ($P > 0.05$). Accordingly, the use of FRCR space maintainers eliminates the problem of rotation/tipping in the abutment teeth, which is normally a matter of concern with the band and loop space maintainers space maintainers.[11]

Although banded space maintainers still remain the gold standard in the management of space in pediatric dentistry. However, FRCR space maintainers such as (everStick,[16,19] Interlig[20]) may be used as an alternative to the conventional band and loop space maintainer. The FRCR used in this study provides an excellent esthetic choice as a space maintainer. It is well tolerated by the patient and less time-consuming. The shortcomings of FRCR space maintainer include relatively greater technique sensitivity. Moreover, limited literature is available that describes these space maintainers in terms of efficacy and longevity.

**Conclusion**

The following can be concluded from this study:

1. Patient acceptability for FRCR space maintainers was found to be significantly higher as compared to conventional band and loop space maintainers

2. FRCR space maintainers were found to be more cost-effective with significantly lower time taken to carry out the procedure than that taken by band and loop space maintainer

3. FRCR space maintainers applied only on the buccal surface of abutment teeth provided equal efficacy as on both sides (buccal and lingual) application of space maintainers used in previous studies

4. FRCR space maintainers were found to be almost equal to that of band and loop space maintainers in terms of clinical performance.

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**Conflicts of interest**

There are no conflicts of interest.

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