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Comparative evaluation of fiber reinforced composite resin over conventional band and loop for space maintenance in children: An assessment of patient acceptance and treatment outcome

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Abstract
Aim: To compare the clinical success rate of Fiber Reinforced Composite Resin space maintainer with that of Conventional Band and Loop space maintainer in children of age group 6-8 years, to evaluate and compare patient and parent acceptance of both the space maintainers.
Methodology: A total of 60 subjects (31 girls and 29 boys) of age group 6 to 8 years requiring space maintenance due to loss of primary molars. Group 1 and Group 2 were the children who received Band and Loop space maintainers and Fiber Reinforced Composite Resin, respectively. At the end of the first, third, and sixth months, the clinical success rate of both types of space maintainers was evaluated. Treatment acceptance during and after the procedure and on follow-up visits was checked using six-point Wong-Baker Faces Scale.
Statistical Analysis: An SPSS version 25 statistical software package was used to conduct the statistical analysis. Quantitative variables were expressed as mean and standard deviation. The unpaired "t" test was utilized to analyze the quantitative variables that were compared between the two groups. Qualitative variables were expressed as frequency and proportion. Using the chi-square test, the comparison of qualitative variables between the two groups was examined. A 'p' value less than 0.05 was considered statistically significant.
Results: This study compared the success rates of 60 space Maintainers; Band and loop and FRCRs in 30 children in the Department of Pediatric Dentistry at Tertiary health care centre, Thiruvananthapuram. 60 fixed space maintainers, 30 band and loop and 30 FRCR space were evaluated at the end of 6 months. The clinical success rate was found to be 83.3% for FRCR and 81.7% for band and loop. However, there was no statistically significant difference. (p>.05). Patients and parents accepted FRCR than band and loop with statistical significance (p<.05).

Keywords: Space maintenance [SM], bonded space maintainers, band and loop [BL], fiber reinforced composite resin [FRCR], Patient acceptance, Wong baker faces scale, esthetics

Introduction

The primary teeth, also referred to as deciduous, milk or baby teeth, are no less important to children than permanent teeth are to adults; a fact, often overlooked by the society [1]. The primary dentition is essential to a child's growth and development. It facilitates mastication, speech, appearance, prevention of undesirable oral habits and guides permanent teeth into position during eruption [2].

Early or premature loss is the term for primary tooth loss before the period of its natural exfoliation and it can lead to variety of problems, including crowding, rotation, and impaction of the permanent teeth, formation of crossbites, differences in the median line of teeth, and supra-eruption of the antagonistic teeth; due to drifting of teeth present mesial and distal to the space, which eventually shortens the arch length required for the succeeding teeth. Additionally, it negatively affects children's emotional health and quality of life [3-5].

With the intent of preventing malocclusion brought on by the early loss of primary teeth, space maintainers can be employed, depending upon the child's dental development stage, the

affected dental arch, the missing primary teeth [4, 6].

Band and loop, one of the most frequently used appliances is a cantilever type fixed space maintainer, has a long history of use with high success rate as a space maintainer.

However, even with good patient compliance, there are still drawbacks such as cement disintegration, solder failure, caries formation, an inability to stop abutment teeth from rotating and tipping, a propensity to become embedded in gingival tissues, caries formation along the band's margins, the requirement for fabrication of cast, the need for a follow-up visit, increased chairside and lengthy construction times [7].

So, researchers in hopes of finding a better alternative for conventional Band and Loop space maintainer, had come up with Fiber reinforced composite resin with much advantages and eliminating most of its shortcomings, which has been successfully used with careful patient selection in our institute. FRCR has been utilized for fabrication of frames of bridges and crowns, removable dentures, for permanent splinting, in resin-bonded bridges, as retainers in orthodontics, and as intracanal posts. The various advantages of this material include its fast application technique, adaptation, and adhesion to dental contours with ease, its robustness and endurance. Hence, FRCR could serve as a superior alternative to the conventional band-and-loop in space maintenance [7-10].

Hence, the present study was designed to evaluate fiber-reinforced composite resin as a space maintainer, to evaluate patient and parent acceptance and efficacy with that of the conventional band-and-loop space maintainer.

Aim

To compare the clinical success rate of Fiber Reinforced Composite Resin space maintainer with that of Conventional Band and Loop space maintainer in children of age group 6-8 years.

Objectives

- To compare clinical success rates of two fixed space maintainers; Fiber Reinforced Composite Resin (FRCR) space maintainers to conventional band and loop Space maintainers in children of age group 6 to 8 years attending tertiary health care setting.
- To compare the patient acceptance of Fiber Reinforced Composite Resin (FRCR) space maintainers to Conventional Band and loop Space Maintainer using Wong Baker FACES Scale.

Methodology

Study Design

Health care centre-based, prospective observational study.

Study Setting

Tertiary dental health care centre, Thiruvananthapuram)

Study Participants

Children who reported to the outpatient wing, Department of Pedodontics and Preventive Dentistry, Tertiary health care centre, Thiruvananthapuram, in the age group of 6-8 years who required space maintenance due to prematurely lost mandibular primary molars, satisfying the inclusion criteria as given below, were chosen for the study.

Verbal assent of subjects above 7 years of age and written consent of parents participating in the study were obtained.

The principal investigator observed and recorded the study procedure done routinely in the Department.

Inclusion criteria

Categories based on the type of space maintainer planned, subjects were allocated into two groups.

Group 1: Children who received Fiber Reinforced Composite Resin space maintainer.

Group 2: Children who received Band and Loop space maintainer.

A. Clinical criteria

1. Prematurely lost mandibular primary first molars in any of the quadrants.
2. Caries free and periodontally healthy abutment teeth.
3. Presence of Angle's Class I molar relationship and/or presence of flush terminal primary molar relationship.
4. 6 to 8-year-old patients for whom either FRCR or Band and Loop space maintainer was indicated.

B. Radiographic criteria

1. No evidence of periapical pathology.
2. Existence of a succedaneous tooth bud.
3. More than one millimetre of bone covering the succedaneous tooth germ and/or root formation only about one-third of the root of the permanent tooth has been completed.

Exclusion criteria

1. Absence of adjacent to edentulous area.
2. Presence of abnormal occlusal relationship such as open bite, cross bite or deep bite.
3. Children with Frankl behaviour rating of 1 and 2.
4. Consent not obtained for the study/procedure.

Sampling

In this study, the sample size was rounded off to 30 in each group; a total of 60 subjects, by Consecutive sampling technique. Verbal assent of children above 7 years and written consent of their parents in the study were obtained. Children who received Fiber Reinforced Composite Resin were categorized as Group 1 and Band and Loop space maintainers as Group 2.

Technique for fabrication and application of FRCR space maintainer: Appropriate length of Ribbond fiber required was calculated by measuring the distance between the disto-buccal line angle of the mandibular primary canine and the distobuccal line angle of the mandibular second primary molar and doubling it. Following the application of a rubber dam, the abutment tooth (mandibular primary second molar) was cleaned and air dried. Adhesive application was done and light-cured for 20 seconds. A thin layer of composite was applied to the abutment tooth's buccal and lingual surfaces. Ribbond fiber was affixed to this composite, running from the buccal aspect of the primary second molar extending towards the primary canine, then forming a loop contacting its distal aspect and the other end was adapted to the composite applied onto the lingual aspect of primary second molar followed by 40 second curing sessions. A layer of flowable composite was applied over the area where the fiber abutted the tooth surface and light cured for 40 seconds. Flowable composite was used to further cover any exposed. Composite finishing burs were used for finishing. For reactivation of the fiber frame, a bonding agent was finally applied and light cured at various spots.

Technique for fabrication and application of FRCR space maintainer

Band and loop space maintainer fabrication was done as per the technique outlined by Graber and Finn and cemented using luting glass ionomer cement (type I) in accordance with the manufacturer's guidelines. Occlusal interference and gingival clearance were assessed. Parents and children received instructions on how to maintain their appliances and practice a good oral hygiene routine.

Outcome Measurement

At the completion of the first, third, and sixth months, every subjects were assessed. Patient and parent acceptability towards the treatment was checked with the help of Wong-Bakers Faces Scale following procedure and by repeated evaluation at the end of 1st, 3rd, and 6th months.

Outcome variables

Clinical success rate of FRCR and Band and loop space maintainers were evaluated at the end of 1st, 3rd, and 6th months by the following criteria.

Group I (FRCR SM) was evaluated for; debonding of enamel-composite interface, debonding of fiber-composite interface, fiber-frame fracture, initiation of carious lesions.

Group II (Band and Loop SM) was evaluated for; cement loss, dislodgement of band, fracture of loop, initiation of carious lesions.

When any of the above-mentioned criteria was observed in the groups under study, the space maintainer was deemed a failure and were refabricated or alternatives were used.

Plan of analysis

An SPSS version 25 statistical software package was used to conduct the statistical analysis. Quantitative variables were expressed as mean and standard deviation. The unpaired "t" test was utilized to analyze the quantitative variables that were compared between the two groups. Qualitative variables were expressed as frequency and proportion. Using the chi-square test, the comparison of qualitative variables between the two groups was examined. A ‘p’ value less than 0.05 was considered statistically significant.

Duration of the study

The study was conducted for a duration of 18 months, 1st to 12th months for the procedure including data collection and 12th to 18th months for analysis and generation of report.

Ethical considerations

IEC clearance obtained from Government Dental College Institutional Ethics Committee IEC (IEC/E/24/2020/GDCT dated 19.12.2020).

Results

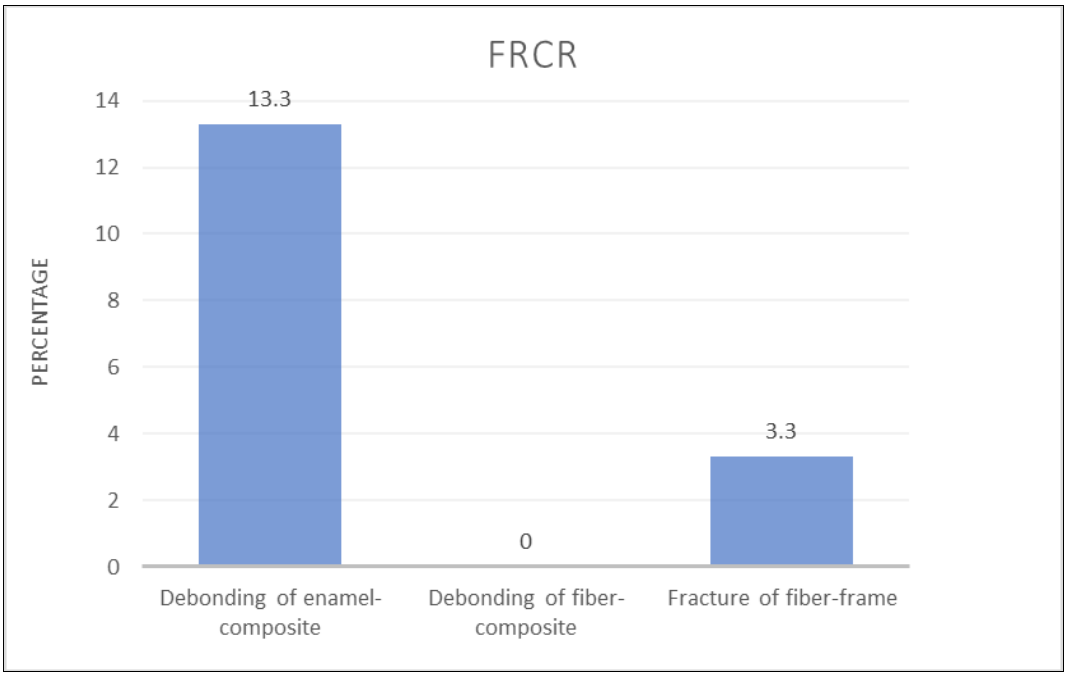
During treatment, in the FRCR group, 8.7% of subjects gave at least score value 2 (hurt little bit) in Wong baker faces scale and 91.3% subjects chose score value 0 (no hurt). In the band and loop group, 16.8% of subjects gave at least score value 2 (hurt little bit) in Wong baker faces scale and 83.2% subjects chose score value 0 (no hurt). In the current study, both FRCR and Band and loop scored a median score of 2 (hurt a little bit) during treatment and median score 0 (no hurt) after treatment

On evaluation at the end of 1st month, 3.33% cases of band and loop failed because of band dislodgement, 6.66% of cases in FRCR group failed because of debonding of enamel-composite interface, FRCR scored a median patient acceptance score of 0 and Band and loop scored 4.

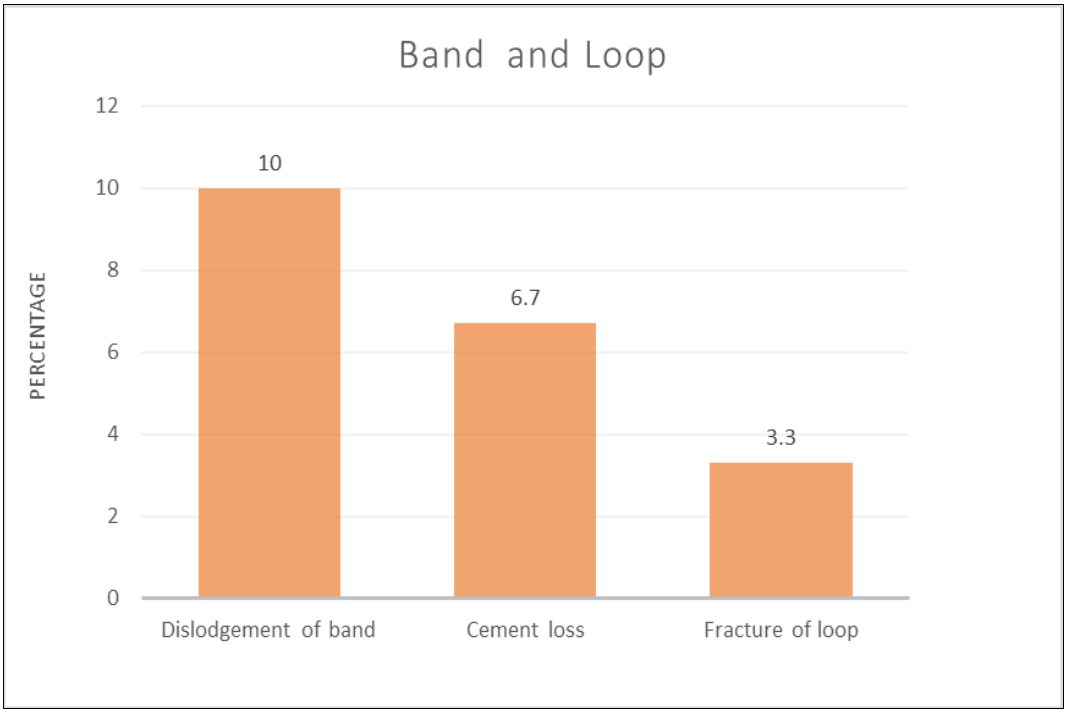
Assessment on completion of the 3rd month, in the FRCR group, 86.6% success was observed. Debonding at the enamel-composite interface was the reason for failure of 13.3% of the cases and fracture of the fiber frame resulted in failure of 3.33% of the cases. 90% success was observed in the band-and-loop space maintainer group, with failure of 6.66% due to band dislodgement and 3.33% as a result of cement loss, FRCR scored a median acceptance score of 0 and Band and loop scored 4. FRCR scored a median parent acceptance score of 0 and Band and loop scored 4

Evaluation on completion of 6 months, FRCR space maintainers achieved 83.3% success. Failure of FRCR SM were as a result of debonding at the enamel–composite interface (13.3%), fiber frame fracture (3.33%) There were no incidence of debonding of FRCR at the composite–fiber interface. The band-and-loop space maintainers recorded 80% success; 10% failed due to band dislodgement, 6.66% due to cement loss and 3.33% due to fracture of loop. No incidence of caries was observed in either group, FRCR scored a median acceptance score of 0 and Band and loop scored 2. FRCR scored a median parent acceptance score of 0 and Band and loop scored 4.

On analysis, even though considering the number of cases FRCR space maintainer performed better than Band and loop space maintainer, difference in success rates was statistically not significant. (p>.05). In terms of patient and parent acceptance, FRCR space maintainer was well received than Band and loop with statistical significance. However, no significant difference was noted with respect to gender as such.



Graph 1: Evaluation of FRCR Space Maintainer



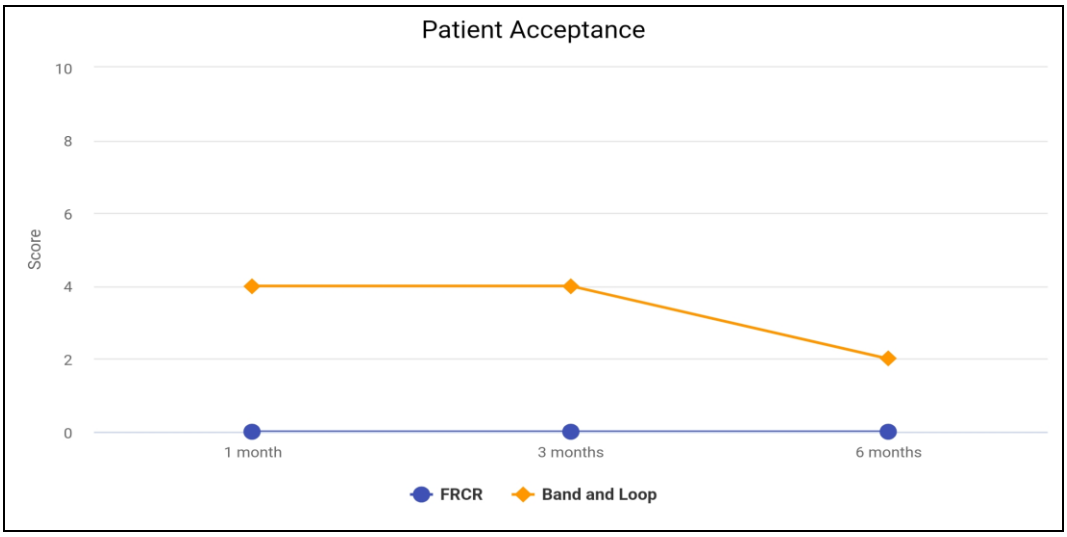
Graph 2: Evaluation of Band and Loop Space Maintainer

Table 1: Comparison of Space maintainers based on patient acceptance score during treatment

	Acceptance during- treatment score		P
	Median	**IQR**	
FRCR	2	0-2	0.943
Band and loop	2	0-2	

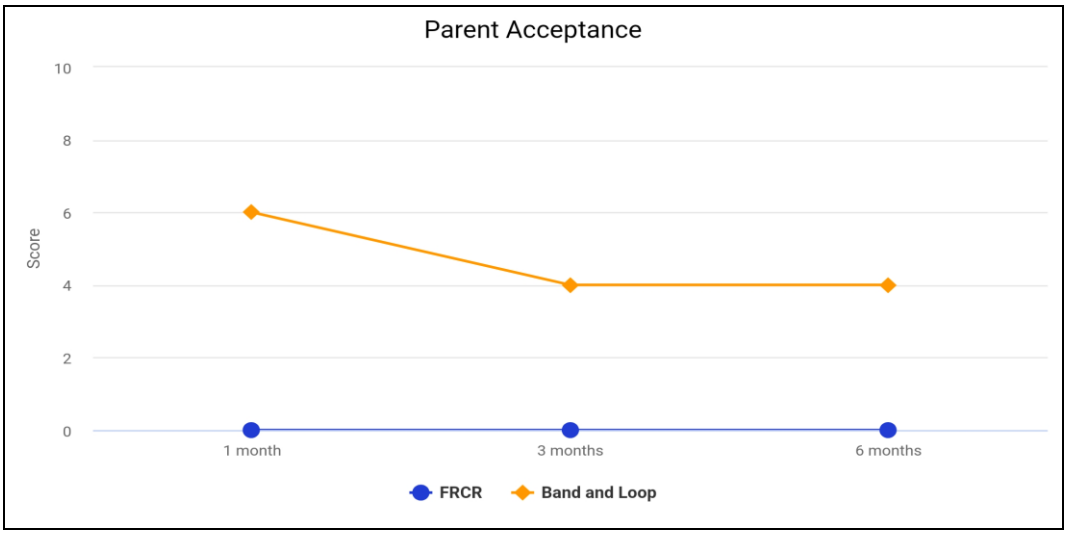
Table 2: Comparison of Space maintainers based on patient acceptance score after treatment

	Acceptance after treatment score		p
	Median	**IQR**	
FRCR	0	0-0	0.232
Band and loop	0	0-0	



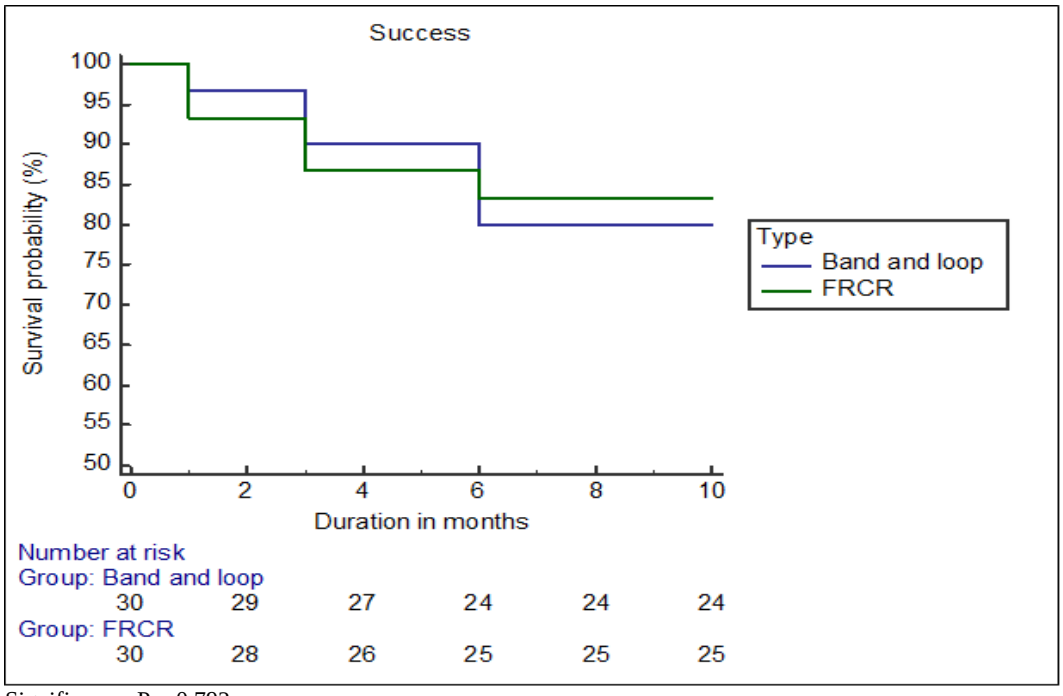
Significance P = 0.042

Graph 3: Patient Acceptance score during follow-up



Significance, P = 0.036

Graph 4: Parent Acceptance score during follow-up



Significance, P = 0.792

Graph 5: Comparison of two groups for cumulative success rate through 6 months of evaluation

Discussion

Band and loop space maintainers are one of the most employed fixed space maintainers. They are cost effective, robust and adapts easily to the changing dentition. Despite their excellent performance history, these banded appliances do have some drawbacks, such as the need for two visits; therefore, cannot be planned for patients under general anaesthesia, necessitates some abutment tooth preparation, may occasionally cause unintended movement or rotation of the abutment teeth, and involves laborious laboratory procedures. Since the appliance is a cantilever design, impingement of the soft tissues could occur if the loop slips gingivally, Carious lesions and gingival inflammation may result from plaque buildup at the band-tooth junction and has potential for allergic reaction to metals [7].

In recent decades, traditional space maintainers have been replaced by direct bonded space maintainers, which are the result of a breakthrough in adhesive technology. They have advantages like easier application, good retention, cost effectiveness, esthetic quality, and good patient acceptance.

Patient and parent acceptance has great importance when considering treatment modalities in in Pediatric Dentistry. As our society advances, more importance is given towards patient comfort and esthetics in addition to the functional aspect of various therapies. FRCR being more esthetically pleasing and comfortably adapting to oral cavity may be a superior alternative to Band and loop as a space maintainer.

Garg *et al.* [15] stated that that patient well accepted FRCR than Band and Loop, FRCR being less hurtful while application and more acceptable which is also evident in the current study where, during treatment, in the FRCR group, 8.7% of subjects gave at least score value 2 (hurt little bit) in Wong baker faces scale and 91.3% subjects chose score value 0 (no hurt). In the band and loop group, 16.8% of subjects gave at least score value 2 (hurt little bit) in Wong baker faces scale and 83.2% subjects chose score value 0 (no hurt), both FRCR and Band and loop scored a median score of 2 (hurt a little bit) during treatment and median score 0 (no hurt) after treatment.

Donna Wong and Connie Baker developed The Wong–Baker Faces Scale (Figure 4), a pain scale employed as a tool to describe or the discomfort or pain that a person experiences. They are used by medical and health care professionals to evaluate patients during and after the course of treatment. The scale shows a series of faces ranging from a happy face at 0, or "no hurt", to a crying face at 10, which represents "hurts like the worst pain imaginable". Based on the faces and written descriptions, the patient chooses the face that best describes their level of pain or discomfort, higher the score means greater the pain or discomfort

In the 1st month follow-up, FRCR scored a median patient acceptance score of 1 and BL scored 3. FRCR scored a median parent acceptance score of 1 and Band and loop scored 4.

At the 3rd month, FRCR scored a median acceptance score of 1 and BL scored 3. FRCR scored a median parent acceptance score of 1 and Band and loop scored 3.

At the 6th month, FRCR scored a median patient acceptance score of 0 and BL scored 1. FRCR scored a median parent acceptance score of 1 and Band and loop scored 2 (Graph 3, 4).

From these results, it is evident that patient and parent acceptance for FRCR space maintainer was significantly superior to Band and loop space maintainer.

At the end of first month, 3.33% cases of Band and loop failed because of band dislodgement whereas in FRCR group, 6.66% of cases failed, the reason being debonding at the enamel-composite interface.

Evaluation on conclusion of third month had shown that FRCR group achieved 86.6% success space. 13.3% cases were considered failure due to debonding at the enamel-composite interface and 3.33% of cases failed due to fiber frame fracture.

In Band and loop group, a slightly higher success was observed. 90% of cases presented with no signs of failure, 6.66% of cases failed due to band dislodgement and 3.33% failed due to cement loss (Graph 5).

At the end of six months, 83.3% success was observed with the FRCR space maintainer which was similar to a study conducted by Simsek *et al.* [9] when evaluated the clinical performance of simple fixed space maintainers bonded by using a flowable composite resin. Band-and-loop space maintainer showed 80% success. Statistical analysis revealed that the success rates of both types of space maintainers did not differ significantly. Although the reasons for failure varied slightly, the results obtained in this study were comparable to the study conducted by Subramaniam P *et al.* [8] in 60 subjects; 30 in each group [8].

In the Band and loop SM group, 10% of cases failed due to band dislodgement the reason may be inadequate moisture control, 6.66% case failed due to cement loss may the reason may also be inadequate isolation during cementation and in 3.33% of cases, fracture of loop (solder breakage) caused failure that may have occurred due to poor quality of construction (due to an incomplete solder joint, overheating of the wire during soldering, a remnant of flux on the wire, over thinning the wire during polishing, or failure to encase the wire in the solder) [8, 11]. No incidence of caries was observed.

Debonding at the enamel–composite interface was seen to be most prominent reason for failure of FRCR SM (13.3%). This could be due to; negative influence of prismless enamel on resin retention [7, 11], tangential and compressive forces acting on the cantilever fiber bridge [7], transmission of forces from fiber frame to bonding margins between tooth and fiber on either side of the framework [12], improper surface preparation, disturbances during the adhesive setting process and moisture contamination. The aforementioned observations made by Tunc *et al.* [12], were in accordance with the studies conducted by Zachrisson *et al.* [13], Soares *et al.* [14].

Second most common reason of failure of FRCR SM was fiber frame fracture (3.33%). This could be due to mastication of hard food or impingement of supra erupted opposing on the fiber frame resulting in mechanical stresses concentration causing fracture [8, 11, 12]. No incidence of debonding at the composite–fiber interface was noted.

Rather than framework fracture, debonding was the most often observed form of failure. Therefore, It is apparent that the proper case selection, operator's expertise and isolation is critical to the success of FRCR SM. The clinical advantages of the FRCR SM are that they provide reduced chairside time and cost, do not require a cast model, easy to apply, provide reliable adhesive bonding and retention, can be used in cases of metal allergy, and provided a natural feel and esthetics.

The results obtained from this study provide conclusive evidence to suggest that FRCR space maintainer was well accepted by both patients and parents when compared to Band and loop. There was a noted trend in increase in acceptance towards both the space maintainers as patient and parent get used to it. However, no significant difference in acceptance was noted with respect to gender as such. In associated survey

conducted among practitioners of Pediatric dentistry in the institution, it was noted that FRCR was preferred as space maintainer when immediate placement of space maintainer was required and when lab facility is unavailable. Most of those who preferred Band and loop appreciated its longevity and considered it more feasible when achieving moisture control was a challenge.

Fig 1: Band and Loop space maintainer

Fig 2: FRCR space maintainer

Fig 3: FRCR space maintainer

Fig 4: Wong–Baker Faces Scale

Conclusion

In this study, patient and parent acceptability and the clinical success rates, of two types of space maintainers - Conventional band and loop space maintainers and Fiber Reinforced Composite Resin (FRCR) space maintainers were compared. Compared to band and loop space maintainers, patient and parent acceptability for FRCR space maintainers was shown to be significantly superior. On a subjective opinion many of the subjects praised the esthetic quality of FRCR. In terms of clinical effectiveness, the Fiber Reinforced Composite Resin space maintainer slightly outperformed the Band and loop space maintainers.

This research provides evidence in favour of an improved alternative to the available varieties of fixed space maintainers, with much ease of fabrication, eliminating impressions and cumbersome laboratory procedures. This method can be effective even in remote areas, can be taken up on a larger scale thus eliminating the occurrence of associated dental abnormalities, even on a community basis, the limitations being resources and awareness. The long-term effectiveness of the space maintainers cannot be inferred from conclusions made after a 6-month follow-up. Hence, we sympathetically prescribe that more clinical research ought to be conducted around the world in arrange to spread mindfulness regarding this proficient, esthetic, simple to form and successful strategy of space maintenance.

Conflict of Interest

Not available

Financial Support

Not available

References

1. King N, Anthonappa R, Itthagarun A. The importance of the primary dentition to children Part 1: Consequences of not treating carious teeth. Hong Kong Practitioner. 2007 Feb 1;29(2):65-70.
2. Kamki H, Kalaskar R, Balasubramanian S, Badhe H, Kalaskar A. Clinical Effectiveness of Fiber-reinforced Composite Space Maintainer and Band and Loop Space Maintainer in a Pediatric Patient: A Systematic Review and Meta-analysis. Int. J Clin. Pediatr. Dent. 2021;14(1):S82-93.
3. Bamashmoos KAO, Alhasani AH, Al-Akwa AAY, Zabara AQMQ, Al-Shamahy HA Wahab, Al-deen HMS, *et al*. Prevalence of premature loss of primary teeth at the age of 6-10 years in Sana'a city, Yemen. Univ J Pharm Res [Internet]. 2020 Sep 15 [Cited 2022 Nov 2];5(9):33-41.
4. Kargul B, Çaglar E, Kabalay U. Glass Fiber-reinforced Composite Resin as Fixed Space Maintainers in Children: 12-month Clinical Follow-up. J Dent Child (Chic). 2005 Sep 15;72(3):109-112.
5. Reddy S. Premature loss of primary teeth on arch dimensions in 6- to 10-year-old schoolchildren in Khammam town, Telangana state [Internet]. [Cited 2022 Nov 2].
6. Achmad H, Taya. The Use of Space Maintainer in Pediatric Dentistry: A Systematic Review. Eur. J Mol. Clin. Med. 2021 Feb 4;8(2):1532-1545.
7. Setia V, Kumar Pandit I, Srivastava N, Gugnani N, Gupta M. Banded vs Bonded Space Maintainers: Finding Better Way Out. Int. J Clin. Pediatr. Dent. 2014;7(2):97-104.
8. Subramaniam P, Babu GKL, Sunny R. Glass fiber–reinforced composite resin as a space maintainer: A clinical study. J Indian Soc. Pedod. Prev. Dent. 2008 Dec 1;26(7):98.
9. Simsek Derelioglu S, Yilmaz Y, Gurbuz T. Clinical evaluation of simple fixed space maintainers bonded with flow composite resin. J Dent. Child (Chic). 2004 May 1;71(2):163-168.
10. Zachrisson BU. Clinical experience with direct-bonded orthodontic retainers. Am J Orthod. 1977 Apr;71(4):440-448.
11. Potgieter N, Brandt PD, Mohamed N. Clinical evaluation of the loop-design fibre-reinforced composite and the band-and-loop space maintainers. SADJ. 2018 Aug;73(7):436-441.
12. Tunc ES, Bayrak S, Tuloglu N, Egilmez T, Isci D. Evaluation of survival of 3 different fixed space maintainers. Pediatr. Dent. 2012 Jul 15;34(4):97E-102E.
13. Zachrisson BU. Clinical experience with direct-bonded orthodontic retainers. Am J Orthod. 1977 Apr;71(4):440-448.
14. Soares FZM, Rocha R de O, Raggio DP, Sadek FT, Cardoso PEC. Microtensile bond strength of different adhesive systems to primary and permanent dentin. Pediatr. Dent. 2005 Dec;27(6):457-462.
15. Garg A, Samadi F, Jaiswal JN, Saha S. Metal to resin: A comparative evaluation of conventional band and loop space maintainer with the fiber reinforced composite resin space maintainer in children. J Indian Soc. Pedod. Prev. Dent. 2014 Apr-Jun;32(2):111-115.

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