ORIGINAL RESEARCH

Comparative Evaluation of Fixed Functional Cantilever Space Maintainer and Fixed Nonfunctional Space Maintainer: A Randomized Controlled Trial

Savitha Sathyaprasad[1], Monika Godilli Krishnareddy[2], Vinisha Vinod[3], Nikhil Das[4], Ramesh R[5], Irfana Ilyas[6]

Abstract

Background and objectives: Effective way to prevent mesial drift after the early loss of primary first molars is by inserting a durable space maintainer. Several space maintainers are available; fixed nonfunctional (FNF) space maintainer (crown and loop) is commonly used when abutment teeth need full-coronal restoration. Disadvantages of crown and loop space maintainer are nonfunctional, nonesthetic, and fracture of solder loop. To overcome this drawback, new design of fixed functional cantilever (FFC) space maintainer (crown and pontic) using bis-acrly composite resin. The study evaluated the longevity and acceptance of an FFC and compared it with a FNF space maintainer.

Materials and methods: A total of 20 healthy children, aged 6–9 years, were selected having bilateral premature loss of lower deciduous first molars. FFC space maintainer in one quadrant and FNF space maintainer in the other was cemented. The subject's acceptance of treatment was checked using a visual analog scale after the treatment completion. Criteria for complication leading to the failure was assessed in both the designs in the 3rd, 6th, and 9th month. Cumulative success longevity was obtained at a 9 month evaluation.

Results: Patient acceptability was greater in group I (FFC) in comparison to group II (FNF). In group I, fracture of the crown and pontic was the common complication leading to failure, followed by attrition of the crown and loss of material due to abrasion. In group II, fracture of the solder joint was the common complication leading to failure, followed by slippage of the loop gingivally and cement loss. The longevity of groups I and II were 70 and 85%, respectively.

Conclusion: FFC can be considered a viable alternative to conventional FNF space maintainers.

Keywords: Esthetics, Pediatric prosthesis, Space maintainer.

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Introduction

Guidance for eruption and development of the primary, mixed, and permanent dentitions is an integral component of comprehensive oral health care for all pediatric dental patients. Preservation of primary dentition plays a critical role in the development and growth of dental arch, esthetics, mastication, and speech, and encourages normal function and expected growth with a major contribution to providing space for their permanent successors till they erupt. Hence well-orchestrated occlusal guidance of permanent dentition contributes to balanced, functional, and esthetically admissible occlusion along with normal successive dentofacial development.[1,2]

Before planning for space maintenance, we need to consider a few points that may affect the treatment options. Premature extraction of deciduous molars results in an increased incidence of space closure. It is well known that the rate and amount of space closure in the mandible occur due to distal movement of the teeth present anterior to the extraction site and if it occurs at an earlier age along with crowded dentition, it results in the reduced dental arch length and would require prolonged orthodontic treatment.[3–5] The premature loss is usually greater in the mandibular arch with the early loss of the right lower first molar (36.81%) followed by lower left first molar (21.82%) and can result in lack of space, midline discrepancies, crowding leading to rotation, opposing teeth supraeruption and permanent teeth impaction, owing to the reduction in the arch length, and disturbance in permanently balanced occlusion.[6] Additionally, it is claimed to have a detrimental effect on children's functional limitations, oral problems, and emotional well-being.[7] Hence, space maintainers should be

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immediately planned to prevent all the complications of early loss of deciduous first molar.

Clinicians monitoring the developing dentition have a crucial duty of space management, with children and parents gaining more preferences on esthetics compared to older days.[8] Paradigm considerations toward the esthetic of a space maintainer, along with other factors, become a preserving issue. Removable space maintainers are worn by patients at their will, may break, may swallow, get lost, may not have the desired effect if not worn enough, and usually restrict the growth of the jaw involved.[9] Among preferable alternative FNF space maintainers (band and loop/crown and loop), which reduce the need for patient and parent compliance, require less regular maintenance, cause less damage to oral tissue because they are less bulky, and are easier for the patient to accept and manage.[5]

Clinicians still prefer to fit a band over a cemented stainless steel crown and create a standard band and loop space maintainer in regard to severely decayed or pulpal-treated abutment teeth; reasons for this preference include (1) practicality and economics by excluding the need for temporary restoration and (2) soldering the loop portion to a stainless steel crown precludes simple appliance removal, adjustment, and replacement.[10] The main reason for the failure of band and loop space maintainers was cement loss.[11] To overcome this disadvantage, crown and loop space maintainers are most preferred, depending on the clinical presentation of the abutment tooth and the intended life expectancy of the space maintainer, among other factors, it is recommended in primary dentition crown and loop over band and loop space maintainers.[10] Crown and loop have certain drawbacks, such as being nonfunctional, nonesthetic, does not prevent supraeruption of opposing tooth, immerging of the loop in the soft tissue, accumulation of plaque, and failure of the solder joint.[5]

There is a requisite to augment the fixed space maintainer with a functional pontic, which would serve the purpose of overcoming the drawback of FNF design of crown and loop space maintainer. An artificial tooth or pontic in a fixed space maintainer replaces the missing natural tooth, restoration of masticatory function, prevention of over eruption of antagonists, compatibility with soft tissues, and is able to last intraorally for an indefinite time without replacement, must facilitate plaque control, be easily cleansable, cause no gingival irritation, and esthetic.[12] The material properties like compressive strength, tensile strength, and hardness should also be sufficient to withstand the forces of mastication without any deflections or distortion. So, there is no one space maintainer which can satisfy all the ideal requirements to date. Hence there is a continuing quest to find a space maintainer which fulfills all the requirements and is also safe and free of adverse effects on children.

For fulfilling all these requirements, a novel FFC space maintainer using bis-acryl composite resin (luxatemp AM plus), introduced as provisional restorative material which contains silica, glass filler, urethane diacrylate, aromatic diacrylate, glycol methacrylate, and additives.[13]

As the manufacturer claims that bis-acryl composite resin (luxatemp AM plus) contains multifunctional monomers, which increase strength due to cross-linking with other monomers and also include inorganic fillers that may have the capability of distributing the load stress and inhibiting the progress of crack propagation. The quick, easy-to-use dispensing automix delivery system saves time, makes easy control of the material, makes consistent mix, prevents material cross contamination, and has superior flexural strength because of a more accurately proportioned.[14] It is endorsed as an extremely accurate provisional restoration with excellent marginal adaptation and negligible linear shrinkage during polymerization, eliminating the need for remargination.[15]

Hence our study primarily evaluates the longevity of the FFC space maintainer in comparison with the FNF space maintainer and the acceptance of the space maintainer design.

Objectives and Aims

To evaluate and compare the longevity of the FFC space maintainer with the FNF space maintainer.

Objectives

- To evaluate the longevity of FFC space maintainer.
- To evaluate the longevity of FNF space maintainer.
- To compare the longevity and acceptance of FFC space maintainer with FNF space maintainer.

Sample Size of Estimation

Sample size (n) = $Z^2_{1-\alpha/2}(2S^2)/d^2$

$S^2 = S_1^2\ S2^2/2$

$S_1 = 1.52$

$S_2 = 1.43$

Confidence interval = 95%

The estimated sample size is = 17

Around 10% of the estimated sample size is added to the calculated sample size to compensate for sampling loss if any; thus, the final sample size accounted for a total of 20 participants in each group.

Materials and Methods

Sources of the Data

A total of 20 participants between the ages of 6 and 9 who met the inclusion-exclusion criteria participated in a randomized clinical investigation.

All parents, other adults, who accompanied the study, and participants' children gave their written and informed consent. The procedure was explained in the local language to the parent, along with the significance of the study.

Method of Collection of Data

A list of subjects satisfying the inclusion criteria/exclusion criteria and those who abide by the instructions of our study was prepared between April and September 2019 from the outpatient register of the Department of Pedodontics and Preventive Dentistry. Among all the willing participants, 20 subjects were randomly included in the study. A split-mouth technique was used for the intervention and a flip-of-coin method was used to segregate the subjects for the intervention, as follows:

- A flip of the coin is headed:
  - Group I (study) = FFC space maintainer (crown with pontic) on the right.
  - Group II (control) = FNF space maintainer (crown and loop) on the left.
- A flip of the coin is tails:
  - Group I (study) = FFC space maintainer (crown with pontic) on the left.
  - Group II (control) = FNF space maintainer (crown and loop) on the right.

Selection criteria for the study and control group:

Inclusion Criteria

Clinical Criteria

- Premature loss of mandibular primary first molar.
- Existence of the flush terminal/mesial step primary molar relationship and/or the Angle's class I molar relationship.
- Abutment in mandibular arch involving primary second molar with the multi-surface caries lesion.
- Prophylactic measure in high caries risk children involving primary second molar in the mandibular arch.
- Developmental disturbance involving primary second molar in mandibular archlike enamel hypoplasia.
- Abutment tooth in mandibular arch undergone pulp therapies like pulpotomy or pulpectomy requiring postendodontic crown placement.
- Participants agreed to the written informed consent and willing to regular follow-up.

Radiographic Criteria

- Lack of radiolucency at the periapex or in the furcation of the abutment teeth.
- The existence of a successor tooth bud.
- The existence of bone >1 mm overlying the successor tooth germ.
- In the permanent tooth, less than one-third of the root developed.

Exclusion Criteria

- Abutment teeth with poor prognosis (mobility and resorption of the root).
- Excessive spacing and crowding.
- Patients with special care needs/differently abled.
- Medically compromised patients.

Armamentarium (Figs 1 and 2)

- Gloves.
- Mouth mask.
- Kidney tray.
- Mouth mirror.
- Explorer.
- Cotton roll.
- Suction tips.
- Air-rotor handpiece.
- Crown cutting burs.
- Micromotor.
- Preformed stainless steel crown.
- Stainless steel 0.036-inch wire.
- Heatless stone bur.
- Band material.
- Hoe plier.
- Bird break plier.
- Band pusher.
- Band seater.
- Band remover.
- Three-prong plier.
- Welding machine.
- Cutter.
- Scissors.
- Impression tray.
- Alginate and elastomeric impression material.
- Inlay wax.
- Glass ionomer cement.
- Wong–Baker Faces Pain Rating Scale.
- Dental stone.
- Self-cure, bis-acryl composite resin and dispensing gun (luxatemp-plus—DMG, Hamburg, Germany) (Figs 3 and 4).

Fig. 1: Preoperative image

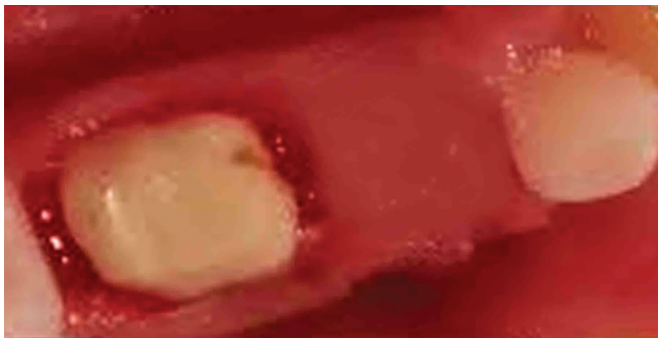

Fig. 2: Crown preparation for group I

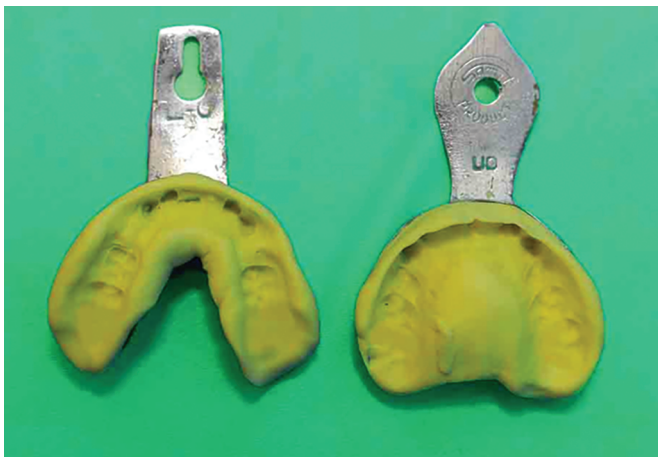

Fig. 3: Elastomeric impression after crown preparation

Methods

Teeth were isolated and anesthetized if needed.

In group I—crown cutting on an abutment tooth that has undergone any form of pulp therapy (pulpotomy or pulpectomy or for the purpose of space maintenance) was done (Figs 5 and 6) and the elastomeric impression was taken (Fig. 7). The cast was fabricated using dental stone and an indirect technique was used in the crown and pontic fabrication. The crown form was made over the prepared abutment tooth along with the pontic using inlay wax in the cast (Fig. 8). Elastomeric impression of the wax buildup was taken, which would act as a template (Fig. 9). FFC space maintainer was fabricated using self-cure, bis-acryl composite resin (luxatemp-plus—DMG, Hamburg, Germany) (Fig. 10) followed by finishing, polishing, and cementation (type I luting glass ionomer cement).

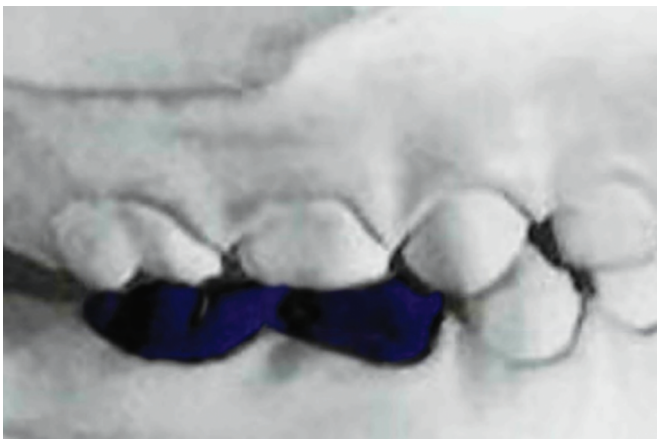

Fig. 4: Model cast and wax preparation

Fig. 7: Luxatemp AM with disperser gun

Fig. 5: Elastomeric impression of wax buildup

Fig. 8: FFC space maintainer (Luxatemp AM plus)

Fig. 6: Luxatemp AM plus

Fig. 9: FNF space maintainer

In group II—crown cutting on an abutment tooth that has undergone any form of pulp therapy (pulpotomy or pulpectomy or for the purpose of space maintenance) was done. An alginate impression with a crown on the abutment was taken and a crown was stabilized on impression material. The cast was fabricated using dental stone. Loop was fabricated and soldered to the crown, followed by placement and cementation (Fig. 11) (type I glass ionomer cement) in any one quadrant.

Usual interference and gingival clearance were examined in both space maintainers. Both the parent and the youngster received instructions on how to maintain dental hygiene and appliances. They were told to follow up if the appliance became loose, displaced, or damaged.

After the treatment was finished, the subject's acceptance of the treatment was evaluated using the visual analog scale (Wong–Baker Faces Pain Rating Scale) attached in proforma. Criteria for complication leading to the failure was used to assess both the designs at the 3–9 months follow-up (Fig. 12) and cumulative success longevity rate was obtained at the 9 month evaluation.

Criteria for complications leading to failure:

Group I

- Cement loss.
- Attrition of crown.
- Loss of material due to abrasion.
- Fracture of crown and pontic.
- Change of physical properties of the material.

Group II

- Loss of cement.
- Deformity of the loop.
- Gingival loop slippage.
- Loop fracture.
- Fracture at the solder joint.

Fig. 10: 3rd month follow-up

Fig. 11: 6th month follow-up

Fig. 12: 9th month follow-up

Result

The study was carried out in case of premature loss mandibular primary first molar and abutment involving the primary second molar with the multisurface caries lesion, high caries risk, developmental disturbance, and undergoing pulp therapies like pulpotomy or pulpectomy requiring postendodontic crown placement. According to 20 patients (14 girls and six boys) in the age group 6–9 years were selected for the study. A split-mouth technique was used for intervention and a flip-of-coin method was used to segregate the subjects for the intervention group.[16]

The primary objective is to evaluate the FFC space maintainer's longevity. Accordingly, out of 20 patients who underwent space maintenance procedures, 14 patients showed clinical success at the end of 9 months of follow-up (Fig. 13).

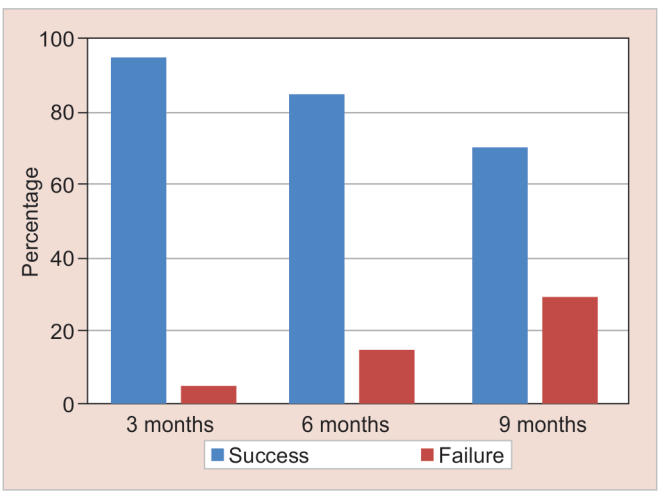

Fig. 13: Showing the longevity of space maintainer at 3rd, 6th, and 9th month evaluation, success (blue), and failure (maroon) of FFC space maintainer

Hence the overall longevity of the FFC space maintainer at 9 months follow-up is 70 % (Table 1).

The clinical longevity of the FNF space maintainer was also assessed simultaneously with the FFC space maintainer. Out of the 20 patients who underwent space maintenance procedures during the 9 month follow-up, 17 patients had achieved clinical success (Fig. 14).

Therefore, at the end of a 9 month follow-up, the overall longevity of the FNF space maintainer is 85% (Table 2).

Overall, comparison of the longevity of FFC and FNF space maintainer at 3rd, 6th and 9th month intervals (Table 3 and Fig. 15).

The next objective was to evaluate and compare the acceptance of the FFC space maintainer with the FNF space maintainer. After the treatment was finished, a visual analog scale (Wong–Baker Faces Pain Rating Scale) was used to assess the patient's acceptance of the treatment (Table 4). Around 70% of patient-reported hurt a little more in the FFC space maintainer group and 60% of patients reported hurt even more in the FNF space maintainer group.

Patient acceptance was greater in FFC space maintainer (group I) compared to FNF space maintainer (group II) and was highly statistically significant ($p < 0.01$).

Complication leading to the failure was used to assess both the designs at the 3rd, 6th, and 9 month follow-up. In group I, the most frequent consequence was fracture of the crown and pontic, which was followed by material loss through abrasion and attrition of the crown (Table 5 and Fig. 16).

In group II, the most frequent consequence was a fracture at the solder joint, which was followed by gingival loop slippage and the loss of cement (Table 6 and Fig. 17).

Cumulative success longevity of both space maintainers in the 9 month, the FNF space maintainer (group II) showed a success rate of 85% as compared to the FFC space maintainer (group I), which has a success rate of 70% (Table 7 and Fig. 18). The statistical difference between group I (FFC) and group II (FNF) space maintainers is ($p = 0.62$) (Table 8).

Table 1: The longevity of FFC space maintainer

	3rd month	*6th month*	*9th month*
Failure	5%	15%	30%
Success	95%	85%	70%
Total	100%	100%	100%

Table 2: The longevity of FNF space maintainer

	3rd month	*6th month*	*9th month*
Failure	0	10%	15.0%
Success	100%	90.0%	85.0%
Total	100%	100.0	100.0%

Table 3: Longevity of both the space maintainer designs

	FFC space maintainer	*FNF space maintainer*
3rd month	95%	100%
6th month	85%	90%
9th month	70%	85%

Discussion

The adage "prevention is better than cure" holds true in the quest to provide the best dental care. The pedodontist is better suited to handle the load of offering the necessary services in these endeavors. The primary prevention level must be used as soon as possible for the preventive approach to be genuinely effective.[15–44]

Table 4: Patient acceptance of space maintainer

Acceptance	*FFC space maintainer*	*FNF space maintainer*
No hurt	0	0
Hurts little bit	4 (20.0%)	3 (15.0%)
Hurts little more	14 (70.0%)	4 (20.0%)
Hurts even more	2 (10.0%)	12 (60.0%)
Hurts whole lot	0 (0%)	1 (5.0%)
Hurts worst	0	0
Total	20 (100.0%)	20 (100.0%)

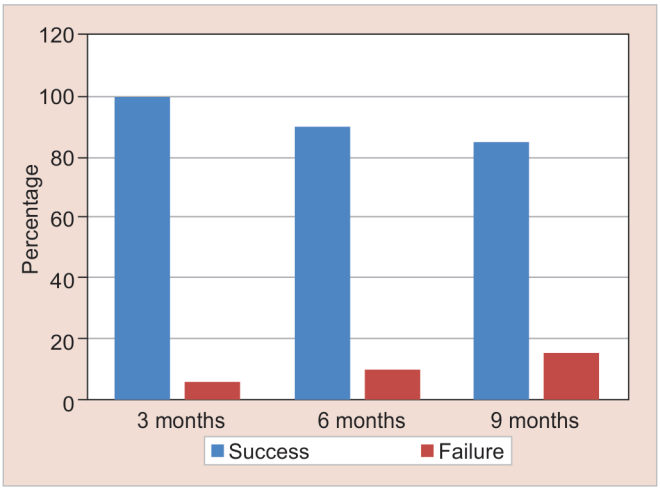

Fig. 14: Showing the longevity of space maintainer at 3rd, 6th, and 9th month evaluation, success (blue), and failure (maroon) of FNF cantilever space maintainer

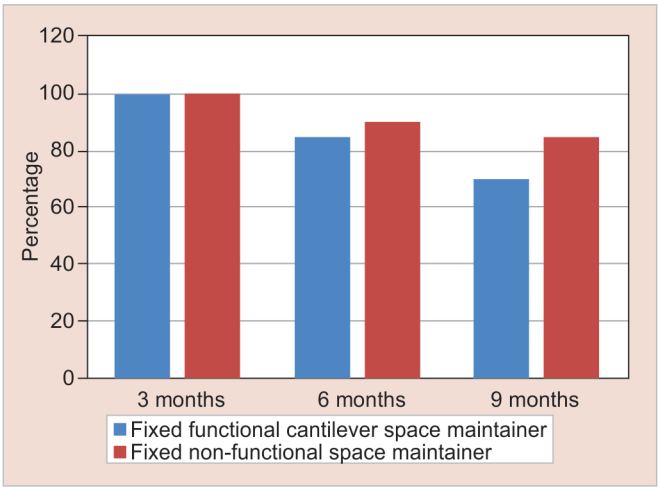

Fig. 15: Longevity of both the space maintainer design at 3rd, 6th, and 9th month. Showing success of FFC space maintainer at 3rd-, 6th-, and 9th month interval (blue) and FNF space maintainer at 3rd, 6th, and 9th month interval (maroon)

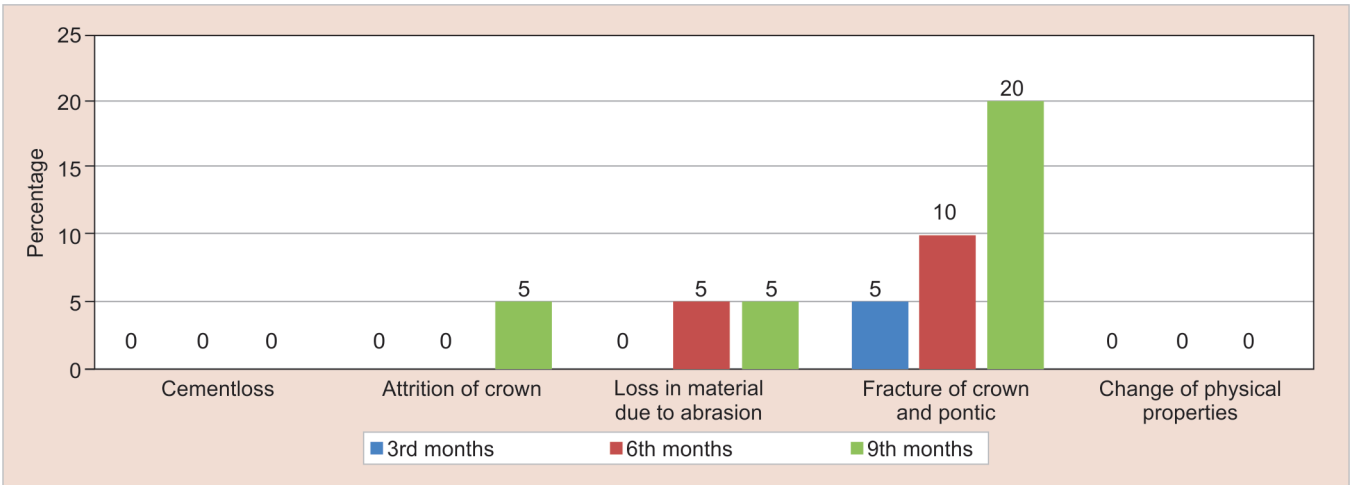

Fig. 16: Complication leading to failure of FFC space maintainer at 3rd, 6th, and 9th month follow-up. The study showed at 3rd month interval failure due to fracture of the crown and pontic (5%). At the 6th month interval, loss in the material due to abrasion (5%) and fracture of the crown and pontic (10%) and at the 9th month interval attrition of the crown (5%), loss in the material due to abrasion (5%) and fracture of the crown and pontic (20%)

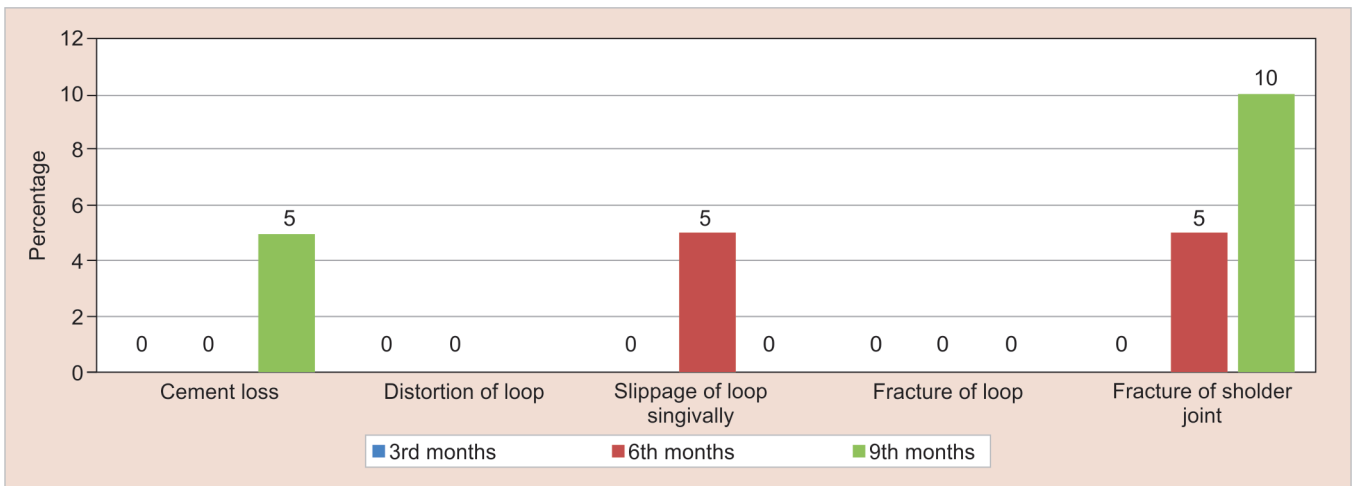

Fig. 17: Complication leading to failure of FNF space maintainer at 3rd, 6th, and 9th month follow-up. The study showed at 3rd month intervals without any complications. At the 6th month interval, gingival loop slippage (5%), fracture at the solder joint (5%), and at the 9th month interval, loss of cement (5%), fracture at the solder joint (10%)

Table 5: Complication leading to failure of FFC space maintainer

Nature of complication	*3rd month*	*6th month*	*9th month*
Cement loss	0 (0%)	0 (0%)	0 (0%)
Attrition of crown	0 (0%)	0 (0%)	1 (5%)
Loss of material due to Abrasion	0 (0%)	1 (5%)	1 (5%)
Fracture of crown and pontic	1 (5%)	2 (10%)	4 (20%)
Change of physical properties of material	0 (0%)	0 (0%)	0 (0%)

Table 6: Complication leading to failure of FNF space maintainer

Nature of complication	*3rd month*	*6th month*	*9th month*
Loss of cement	0 (0%)	0 (0%)	1 (5%)
Deformity of loop	0 (0%)	0 (0%)	0 (0%)
Gingival loop slippage	0 (0%)	1 (5%)	0 (0%)
Loop fracture	0 (0%)	0 (0%)	0 (0%)
Fracture at the solder joint	0 (0%)	1 (5%)	2 (10%)

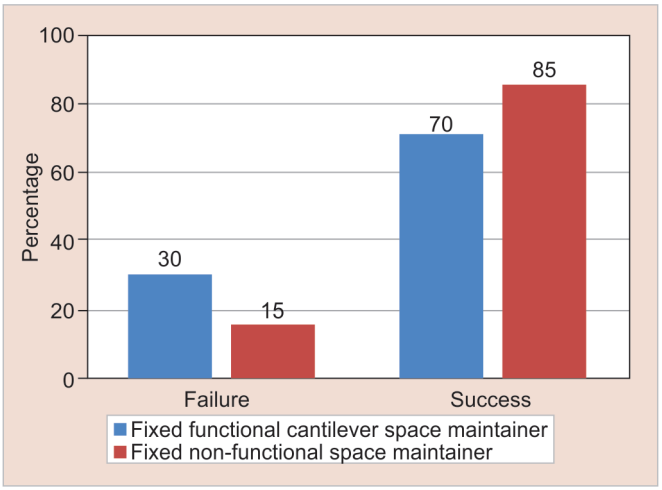

Fig. 18: Showing the cumulative success longevity at the 9th month, FFC space maintainer (blue) and FNF cantilever space maintainer (orange)

Table 7: Cumulative success longevity at 9th month interval

	FFC space maintainer	*FNF space maintainer*
Failure	30%	15%
Success	70%	85%
Total	100%	100%

Table 8: Test statistics

	Success/ failure in the 9th month	*Patient acceptance*
Mann–Whitney *U* test	150.000	102.000
Wilcoxon W	360.000	312.000
Z	−1.869	−2.857
Asymptomatic significance (2-tailed)	0.062	0.004
Exact significance [2(1-tailed significance)]	0.183	0.007

Inserting a sturdy space maintainer is the most efficient technique to stop mesial migration and distal drifting following an early primary molar loss.[45] To prevent the early emergence of malocclusion-related characteristics, space maintenance has been prioritized based on the patient's growth, dental arches development, and willingness to cooperate; either fixed/removable space maintainer can be advocated.

Removable functional space maintainer using acrylic pontic will help in replacing a missing tooth in the dental arch, improve mastication and prevents supraeruption, but have several disadvantages like low retention, a child's reduced tolerance, and a high likelihood of appliance dislodgement. A review by Ahmad, Parekh, and Ashley reported that complete loss of the appliance was the most frequent reason for failure for the removable space maintainer.[37] This calls for fixed space maintainers for definite periods of space maintenance. Fixed space maintainer preserve the space in either arch generated by the unilateral or bilateral early loss of primary teeth. The appliance mainly used are lingual arch, band and loop, and crown and loop.[46]

To date, many designs are tried; still, crown and loop and band and loop remain the most often utilized space keeper. However, crown and loop are usually indicated with additional criteria of the grossly carious or after pulp therapy of abutment, where full coronal restoration is needed.[47] However, it fails to restore the occlusal requirement of the lost tooth; hence there is a need to give more emphasis on replacing a missing tooth with a pontic. Pontics or prosthetic teeth are artificial teeth used to restore both function and esthetics by replacing natural teeth. Nowadays, to save space after eliminating some teeth, replacing the missing tooth is an esthetic problem for dentists. Pontic is compatible with good oral health and comfort. The pontic should be carefully designed during fabrication in order to accommodate current occlusal issues and facilitate plaque control. However, caution is required for the erupting premolar that may need multiple follow-up.

The literature indicates a different material used to replace the missing tooth with pontic, employing fibre-reinforced composites in unilateral functional space maintainer as an alternative to the traditional band and loop appliance; in a study conducted by Kamal and Mohammed has been reported to be better in clinical performance, dental health and satisfaction of parent and child.[35] Vinothini et al. used cold cure acrylic to adhere an acrylic tooth serving as a pontic to a modified band and loop metal framework of traditional design.[39] Another modification, pontic-crown space maintainer, has been reported by Eshghi, Tayaran, and Mosleh in which the preformed crown of the primary first molar was selected as pontic-according to empty space, and if needed, its occlusogingival length was shortened and soldered to abutment crown. When treating the early loss of primary molars, the pontic-crown space maintainer is an effective substitute for the band and loop space maintainer.[38] These designs allow the physiologic canine movement to happen with the emergence of the permanent incisors in addition to restoring masticatory function and limiting opposing teeth movement.[16] Hence, there is a need to give more emphasis on replacing a missing natural tooth with a pontic, which led to the innovation and fabrication of a crown and pontic that is an FFC space maintainer design where one end there are abutments, and the other end is unsupported. The design helps in establishing balanced contact to stop migration and tilting. In this study, we have tried using bis-acryl composite resin (luxatemp-plus DMG, Hamburg, Germany).

In the early 1960s, Dr Rafael Bowen started incorporating inert filler particles into self-curing methacrylate derivatives. He created the high molecular weight, dual-functional monomer bisphenol A glycidyl methacrylate (bis-GMA), also known as Bowen's resin, in 1962. The first resin composite to be utilized in dentistry was this invention. The structure and filler content of bis-GMA were further developed, resulting in the creation of other molecules such as ethoxylated bis-GMA, trimethylene glycol dimethacrylate, and urethane methacrylates. Due to all of these advancements, contemporary composites have been created (Rueggeberg 2002). The advances have led to the bis-acryl resins becoming quite well-liked.

Bis-acryl composite resins (luxatemp-plus DMG, Hamburg, Germany) contain multifunctional monomers that strengthen materials by cross-linking with other monomers. They also contain inorganic fillers that might be able to disperse load stress and slow the spread of cracks. The amount of inorganic filler, the size of the filler particles, and their distribution all help to increase the strength and elastic modulus. At various levels after polymerization, Balkenhol et al. assessed variations in the mechanical characteristics of chemical and dual-cure interim fixed materials.[35] Trim (self-curing

methacrylate), luxatemp AM Plus (self-curing bis-acryl), luxatemp AM plus solar (dual cure bis-acryl), and cool temp natural (self-cure bis-acryl) were the materials examined. According to Balkenhol et al., the dual cure material provided the highest strength in the shortest time period tested, with the time after first mixing having a major impact on the material's flexural strength. Comparing the flexural strength of the bis-acryls to the methacrylate.

Cartridge-based dispensing devices were employed to dispense the bis-acryl composite resin (luxatemp-plus DMG, Hamburg, Germany) materials used in this investigation. This may have improved the flexural strength due to a more precisely measured and uniform mix. However, due to their usefulness, minimum polymerization shrinkage, low exothermic reaction, and highly pleasing esthetic appearance, bis-acrylic composite resins have become more popular.

The goal of the study was to compare the FFC space maintainer's acceptance and durability to that of the FNF space maintainer in cases of early loss of lower primary first molars.

A total of 20 patients diagnosed with symmetrical premature loss mandibular first primary molars and abutment in mandibular arch involving primary second molar requiring crown placement for a multisurface caries lesion in high caries risk children, developmental disturbance like enamel hypoplasia and pulp therapies like pulpotomy or pulpectomy requiring post endodontic crown placement were indicated for space maintenance with split-mouth technique. First permanent molars could not be banded since they had not fully emerged. In addition, not every permanent mandibular incisor erupted. So, we had to go for a bilateral space maintainer instead of the lingual arch. For the sake of comparison, both traditional and innovative fixed space maintainers were provided in each quadrant. Thus, neither sort of space maintainer denied the benefits to any child. We could examine and compare space maintainers in the same environment of nutrition, oral hygiene, and occlusal stresses since they share the same oral cavity. The clinical parameter assessed in this study were complications leading to failure, patient acceptance, and cumulative success at the end of the 9 months.

The feasibility of the FFC space maintainer was assessed based on the longevity of the space maintainer in the oral cavity. The longevity of the appliance was tested at 3rd, 6th, and 9th month intervals. At 3rd month interval, the FFC space maintainer showed a success rate of 95%, pointing out that the material properties containing organic matrix, inorganic filler particles, and typical monomer characteristics provide better mechanical qualities, low-temperature fluctuations, decreased polymerization shrinkage, and superior polishing, which increases the feasibility of manufacturing temporary space maintainers and immediately following appliance implantation, patients were more cautious. It was also likely that during this time, parents were more watchful and stricter with their adherence to posttreatment guidelines.[31]

And the failure of the FFC space maintainer at 3rd month was 5% due to fracture of crown/fracture of the crown and pontic, which continued till 9th month. The reason for failure was due to reduced crown length for crown preparation, which would have resulted in reduced crown material thickness, masticatory loading, ambient oral cavity conditions, deterioration of the matrix and fillers, microcracks, and debonding between fillers and matrix. Failure starts at the submicroscopic level when faults are loaded, and cracks start to propagate on the restoration's surface.

Results of the FFC space maintainer in the 6th month showed longevity of 85%. It is crucial to maintain occlusal connections throughout the time until the permanent tooth erupts, even though provisional restorations are employed as space maintainers for a brief length of time. Loss of occlusal structure/anatomy and altered/reduced vertical dimensions of repaired teeth may cause parafunctional habits.[14] If breakage of an appliance occurred during this time, space maintainers were taken out of service and either repaired or replaced, and these cases were considered further in the study. Failures in FFC space maintainer were maximum due to loss of material due to abrasion (5%) and fracture of the crown and pontic (10%). Additionally, the deterioration of the surface texture and the creation of fracture foci from the masticatory function may result from the abrasion/wear progression of a provisional restoration.[14]

At 9th month interval, the FFC space maintainer showed longevity of 70%; the reason for the high failure rate seen in this report was due to the young age of participants (mean 6 ± 0.65 years). According to Fathian et al., the patient's young age was a significant contributing factor to space maintainer failures. Young patients, according to the authors, demonstrated less cooperation, ate more sticky food, and had shorter crown lengths available for crown preparation.

The longevity of the FNF space maintainer was also assessed at 3rd, 6th, and 9th month intervals. At 3rd month interval, the longevity of the FNF space maintainer was 100% due to soldering the wire loop directly to the preformed stainless steel crown prior to cementation, then cementing a stainless steel band to a stainless steel crown in the oral environment is not generally successful for extended time periods. In this study, loops were directly soldered to a preformed stainless steel crown using an indirect technique.

At the 6th month interval, the longevity of the FNF space maintainer was 90 and failure of 10%, due to gingival slippage of the loop (5%) and fractured at the solder joint (5%), which continued till the 9th month. The current study's findings are in accordance with Croll finding that unilaterally fixed stainless steel appliances with solder wire loops lose appropriate contact with the nonattached abutment tooth and becomes submerged gingivally. Other problems that could contribute to the failure of space maintainers include: younger children fiddling or playing with the space maintainers, which results in wire deformation and loop submerging gingivally.[10]

The success longevity at the end of the 9th month was 85% and failures due to cement loss (5%) due to improper isolation and increased intake of sticky food and solder breakage (10%) due to poor construction practices, including inadequate solder joints, scorching of the wire while soldering, thinning of the wire by polishing, and failure to completely encase the wire in the solder.[47] The findings of the current investigation were contradictory with those of Qudeimat and Sasa, which compared the clinical effectiveness and longevity of band and loop to crown and loop space maintainers and claimed solder fracture was the primary reason for failure for crown and loop space maintainers.[10] Comparing the crown and loop space maintainer for solder breakage, which is also one of the causes of band and loop space maintainer failure, is a subject of very few studies. The results of the current study are consistent with those of Raviteja and Prasad, who compared Ghana Shyam's telescopically expanding fixed functional space maintainer to a conventional band and loop space maintainer.[9]

While comparing the intergroup longevity, both the groups showed a difference of 5% in success at 3rd, 6th, and 9th month intervals.

In this study, we evaluated patient satisfaction and comfort with treatments involving space maintainers might be different, and lack of child satisfaction may lead to attempts to break, destroy, or remove the space maintainer. A Wong–Baker Faces Pain Rating Scale was used to assess the patient acceptance of the treatment immediately following the delivery of the appliance. This scale had good psychometric properties and was quick, affordable, and simple to use. It was also widely accepted. Parents and kids of all ages preferred it above all other faces pain scales. The Wong–Bakers pain assessment scale was used in the study by Garg et al. to assess patient acceptability.[31]

Patient acceptability of FFC and FNF space maintainers is now considered a key part of the healthcare quality improvement initiative. A satisfied patient is more likely to adhere to the recommended course of treatment. Patient acceptance is greater in FFC space maintainers as compared to FNF space maintainers. The reason for the success of FFC space maintainers is because of its esthetic appearance; it replaced the missing tooth, had no chance of harming the abutment teeth, and was simple to clean.

Patient acceptance was greater in FFC space maintainer (group I) compared to FNF space maintainer (group II) and was highly statistically significant ($p < 0.01$).

The failure rate of FFC and FNF space maintainer was 35 and 15% at the 9th month interval. FNF space maintainer had a significantly lower failure rate (15%) due to a fracture at the solder joint, which was contradictory to the study conducted by Qudeimat, Sasa.[10] FNF cantilever space maintainer had a failure rate (35%), maximum due to fracture of crown and pontic interface. It is not possible to compare studies because none have looked into the success rate of FFC space maintainers made of bis-acryl composite resin.[48] According to Brill WA (2002), an appliance is successful if it helps the patient in the way it was intended to, even if it requires maintenance or repair while the patient is receiving treatment. Clinicians are advised to choose space maintainers with the knowledge that the maintenance period will probably require replacements, repairs, and possibly a number of different types of space maintainers until the end of therapy.[49]

When comparing the cumulative success longevity at the 9th month interval of both space maintainers, it was 70% success in FFC and 85% for FNF space maintainer. The space maintainer between group I (FFC) and group II (FNF) did not differ statistically significantly ($p = 0.62$).

This study shows that the FFC space maintainer had better longevity with a success rate of 70%. Hence future studies on FFC space maintainers have to be carried out to check other parameters and further longevity in the oral cavity for premature loss of primary molar.

The following conclusions were reached based on the methodology used, the data that was recorded, and the statistical analysis that was performed in the current study.

Conclusion

Patient acceptance of the FFC space maintainer was found to be better than that of the FNF space maintainer.

The overall longevity of the FNF space maintainer was better than FFC space maintainer.

In terms of clinical effectiveness, FFC space maintainers were discovered to be superior to FNF space maintainers.

This novel FFC space maintainer may thus be an alternative to the traditional FNF space maintainer; it can be inferred from the study.

This study endorses the esthetic benefits of bis-acryl composite resin (Luxa temp-Automix DMG, Hamburg, Germany) along with the functional efficacy that is required for short-term longevity of 2 years expected for a space maintainer to be fulfilling the functional and esthetic concerns, the bis-acryl composite resin contains multifunctional monomers, which increase strength, excellent marginal adaptation and negligible linear shrinkage during polymerization. Thus, within the limitation of the study, bis-acryl composite resin (Luxatemp-Automix DMG, Hamburg, Germany) can be used as an esthetic space maintainer. However, in this study, longevity for space maintainers for 9 months was evaluated, and further studies have to be carried out over more time periods.

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