Glass Fiber–reinforced Composite Resin as Fixed Space Maintainers in Children: 12–month Clinical Follow–up

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ABSTRACT

Purpose: The purpose of this clinical evaluation was to assess fixed space maintainers for child patients whose missing primary molars were replaced with space maintainers made with everStick during a 12-month follow-up period. EverStick is a semi-manufactured product made of glass fibers, thermoplastic polymer, and light-curing resin matrix for reinforcing the dental polymer.
Methods: Twenty-three clinical cases presented in this paper were evaluated in the Department of Pediatric Dentistry, Marmara University, Istanbul, Turkey. EverStick was used as part of a space maintainer on occasions where 1 or 2 teeth were lost in either the maxillary or mandibular arch.
Results: This study showed that the glass fiber-reinforced composite resin space maintainers functioned well during a mid-term evaluation.
Conclusions: Clinical advantages of everStick include: (1) cost and time savings; (2) no need for a cast model; (3) no second visit; (4) easy to apply; (5) reliable adhesive bonding; (6) no metal allergy; (7) easy to clean; (8) natural feel; and (9) esthetically desirable. (J Dent Child 2005;72:109-112)

KEYWORDS: GLASS FIBER-REINFORCED COMPOSITE RESIN, SPACE MAINTAINER

One determinant of future occlusion status is seen within the primary dentition. The exfoliation of the primary teeth, eruption of the permanent teeth, and the occlusion are independent; they occur, however, in a harmonious sequence.[1,2] There are many morphogenetic and environmental influences affecting the occlusal development, and a disorder in any of these elements may influence the occlusion.[3]

One of these factors is premature exfoliation of primary teeth. Premature primary tooth loss has been known to cause space loss, resulting in malocclusion. The maintenance of such space may eliminate or reduce the need for prolonged orthodontic treatment.[4,5] When a primary molar tooth is extracted or exfoliated prematurely, the teeth both mesial and distal to the space tend to drift or be forced into it.

To avoid malocclusion as a result of premature loss of primary teeth, various types of space maintainers (removable or fixed appliances) can be used, depending on: (1) the child's stage of dental development; (2) the dental arch involved; (3) which primary teeth are missing; and (4) which teeth are involved.[1,6-10] Removable appliances may be worn at the patient's convenience. They may, however, be broken, lost, and have insufficient effect if not worn enough. If properly designed, fixed appliances are less damaging to the oral tissues and are less of a nuisance to the child patient because they are worn continuously and are, therefore, more appropriate for longer periods.[11-13]

Today, technology allows the opportunity to test new materials for use as space maintainers. Glass fiber-reinforced composite resins (FRCRs) are new to the pediatric dental market, and they can be used as an alternative for space maintenance. FRCRs have been developed for dental applications in recent years.[14-23] There has been increased interest in FRCRs in dentistry. FRCRs have been used in removable prosthodontics, fixed partial dentures, periodontal splints, and in orthodontic treatment as a retention splint.

A recent introduction is a new FRCR material composed of densely packed silanated E glass fibers in a light-curing gel matrix (everStick, Stick Tech Ltd, Turku, Finland). The clinical success of a fixed partial denture is dependent on good

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marginal integrity, adequate rigidity, and strength of the construction. Rigidity and strength of such appliances made from FRCR are dependent on the polymer matrix of the FRCR and the fiber reinforcement type.[24] For example, by using continuous unidirectional fibers in the FRCR, the material's strength and rigidity can be considerably enhanced.

EverStick is a translucent-colored and semi-manufactured product. The matrix contains poly(methylmethacrylate), or PMMA. PMMA chains in a bisphenol A glycidyl dimethacrylate (bisGMA) matrix encapsulated by a PMMA layer to improve handling as well as bonding properties.[25] This clinical evaluation assesses the 12-month follow-up of patients whose missing primary molars were replaced with resin-bonded space maintainers.

METHODS

Clinical cases presented in this paper were performed in the Department of Pediatric Dentistry, Marmara University, Istanbul, Turkey. After intraoral and radiographic examinations (periapical and panoramic radiographs), children with the need for space maintainers were selected. Nineteen children with good general health and age-appropriate cognitive development were included in the study group. Parents were informed about the clinical evaluation. Informed parental consent for the child's participation was received.

All space maintainers were applied according to the method described by Kargul et al.[21,22] Caries or old fillings were removed, and grooves in mesiodistal directions were drilled where needed. Space length of lost teeth was noted orally prior to the appliance's fabrication. Preimpregnated glass FRCR (everStick) was cut to reach from the distal edge of one tooth to the mesial edge of the other tooth based on the intraoral measurement. The prepared dental surfaces were cleaned with pumice, etched with 35% phosphoric acid, rinsed, dried lightly, and wetted twice with light-curing adhesive (Prime&Bond, Vivadent, Schaan, Liechtenstein). Next, the surfaces were dried again lightly and light cured. A thin layer of flowable composite (Tetric Flow, Vivadent, Schaan, Liechtenstein) was applied to the tooth surfaces or cavity without light cure. EverStick fibers were inserted into the StickPen applicator (Stick Tech Ltd, Turku, Finland) according to the manufacturer's instructions and positioned simultaneously onto the intended area.

After the preliminary curing was done for both teeth, the restorative composite was cured for 40 seconds at several different points. Excess luting cement was removed, and the occlusion was carefully checked. Appropriate polishing was applied on all surfaces. EverStick space maintainers from different arches are shown in Figures 1 and 2.

A total of 23 space maintainers were classified as: (1) 1 or 2 teeth lost; and (2) maxillary or mandibular arch. Patients had hygiene control appointments at 1 week and were checked 6 months after the procedure. At the end of 12 months, all children were evaluated for survival time of the space maintainers. Data was entered into a computer and analyzed using SPSS 10.0 for Windows (SPSS Inc, Chicago, Ill). Statistical analysis was performed using the student *t* test. Statistical significance was established at the $P<.05$ level.

Figure 1. Upper fiber-reinforced composite resin space maintainer III to V.

Figure 2. Lower-reinforced composite resin space maintainer III to V.

RESULTS

This study investigated the longevity of 23 space maintainers made of glass FRCRs fitted in 19 children (5 girls and 14 boys) in the Department of Pediatric Dentistry at Marmara University Dental School. The mean age of the children was 8.4±1.2 at the beginning of the study. Twenty-three space maintainers were evaluated at the end of 12 months. Survival rate and whether damage to the abutment teeth occurred were evaluated. During this period, no damage to the abutment teeth was found.

Of the 23 space maintainers evaluated, 13 failed and 10 were successful. The clinical success rate was found to be 43% (10), while 57% (13) of the space maintainers needed to be replaced because of bonding failure at the end of the study period. The differences, however, were not statistically significant ($P>.05$). The mean survival time for failed space maintainers was found to be 5 months. The survival time of space maintainers for the maxilla was longer than

in the mandible. Failure causes were thought to be bonding failures. Space maintainers for 1 tooth lost survived longer than space maintainers for 2 teeth lost.

DISCUSSION

EverStick is a translucent-colored, semi-manufactured product made of glass fibers, thermoplastic polymer, and a light-curing resin matrix for reinforcing the dental polymer. The use of fiber-reinforced plastics in dentistry is increasing. FRCRs have been used in the past to replace missing teeth.[14] EverStick is a new alternative to conventional fixed space maintainers and has been evaluated and used in pediatric dentistry, namely for band-and-loop type appliances.[21,22]

Tulunoglu et al evaluated the median survival time of fixed and removable space maintainers.[26] Three hundred forty-five space maintainers were considered lost to follow-up, 83 were considered to have failed, 206 were successful, and 20 were not considered or evaluated. The appliances' overall median survival time was 6.51 months. Median survival time of space maintainers was 7.17 months for the maxilla and 6.69 months in the mandible. Median survival time was 5.25 months for space maintainers fabricated in both arches.[26] The mean survival time for failed FRCR space maintainers was found to be 5 months. The survival time of FRCR space maintainers for maxilla was longer than in the mandible. Failure causes were thought to be bonding failures. FRCR space maintainers for 1 tooth lost survived longer than space maintainers for 2 teeth lost.

Simsek et al evaluated the clinical performance of simple fixed space maintainers bonded by using a flowable composite resin. The patients were followed up for 12 to 18 months. Five percent of space maintainers were determined to be unsuccessful at the end of the study period. Finally, it was observed that the use of simple fixed space maintainers was successful due to operator experience and the choosing of favorable patient groups.[27]

This clinical evaluation showed that the FRCR space maintainers functioned well over 5 months. Qudeimat and Fayle investigated the longevity of 301 space maintainers fitted in 141 patients aged 3.4 to 22.1 years. Failure occurred in 190 space maintainers (63%), of which 36% was due to cement loss, 24% due to breakage, 10% due to design problems, and 9% were lost. Using the life table method, the median survival time for space maintainers was found to be 7 months.[28]

Rajab investigated the clinical performance of 387 space maintainers fitted in 358 patients aged from 3 to 9 years. Failure occurred in 119 appliances (31%), of which 50% was due to solder breakage: 33% from cement loss; 11% from soft tissue lesions; 4% from eruption interference; and 2% were completely lost. Bands and loops, Nance appliances, and removable partial dentures had a similar survival probability. Fixed bilateral mandibular appliances recorded a lower survival time than fixed bilateral maxillary appliances.[29]

The use of FRCR materials can reduce tooth preparation, which is essential for prevention—one of pediatric dentistry's major aims. FRCR space maintainers are easy to apply, rely on adhesive bonding, and generally require one visit. McDonald and Avery suggested that band and loops should be removed once a year to inspect, clean, and apply fluoride to the tooth.[30] FRCR may eliminate these annual steps and offer several benefits:

1. They do not make any contact with adjacent periodontal tissues, thereby eliminating periodontal problems affiliated with conventional fixed space maintainers.[21,22]
2. They cover less space in the oral cavity, making them feel natural and easy to clean.
3. Laboratory procedures are eliminated, and there are no casts.
4. The use of FRCR space maintainers can be successful with careful patient selection.

CONCLUSION

Fiber-reinforced composite resin space maintainers (everStick) may be a viable alternative to conventional fixed space maintainers used in pediatric dentistry.

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