

EVALUATION OF SPACE MAINTAINERS FABRICATED BY DENTAL STUDENTS: A RETROSPECTIVE STUDY

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ABSTRACT

The purpose of this retrospective study was to evaluate the performance of space maintainers inserted by male undergraduate students in the College of Dentistry at King Saud University during the academic year 2006-2007. Dental records of children who had at least one space maintainer manufactured for them were reviewed. Two interns examined the selected patients and assessed the performance of space maintainers which was categorized into four groups: successful/removed, successful/currently functioning, failed and lost to follow up. One hundred and three children who had a total 130 space maintainers were examined. The mean age of the patients was 8.4 (± 1.39) years, and the mean time elapsed between the insertion of the appliance and examination was 19.6 (± 7.43) months. The overall performance of the space maintainers showed that, 42 (32.3%) of the appliances were successful (7.7% were removed and 24.6% still functioning), 26 (20.0%) lost to follow-up and 62 (47.7%) failed. The most common cause of space maintainer failure was complete loss of the appliance followed by breakage and cements loss. There was no significant difference in the performance of space maintainers in terms of age group, gender, arch and type of space maintainer. It can be concluded that about one half of space maintainers inserted by dental students failed in less than two years. Close observation and regular follow-up of the appliances should be emphasized to avoid such outcome.

Keywords: Space maintainers, dental students, children.

INTRODUCTION

Premature loss of primary teeth may harm the normal occlusion development. Drifting of adjacent primary and permanent teeth into the available space created by the premature tooth loss may compromise the eruption of the succedaneous teeth.¹ However; immediate insertion of space maintainers can preserve arch length and minimize the malocclusion development.¹ Different types of space maintainers can be utilized depending on the factors such as child's stage of dental development, dental arch involved, number of teeth and arches involved and type of teeth lost.^{2,3}

Few studies have assessed the clinical effectiveness of space maintainers.⁴⁻⁸ Hill *et al* (1975)⁴ evaluated 226 space maintainers inserted in an extensive dental care program and followed over a period of 4 years. They reported failure in 43% of the cases. The most common problem showed in their study was appliance loss which constituted 37% of the total failure, while 27% were due to broken and 14% due to failure of cementation.⁴ Baroni *et al* (1994)⁵ evaluated 88 fixed space maintainers fitted by faculty in Pediatric Dentistry Department of University of Bologna, Italy and followed-up for a maximum of 53 months. The overall

incidence of failure was 30.5%; solder failures accounted for 37% of the total failures, 33% were due to loss of cement and 19% involved soft tissue lesions. Qudeimat and Fayle⁶ in their retrospective study on longevity of space maintainers inserted in the Department of Pediatric Dentistry at Leeds Dental Institute United Kingdom by postgraduate dental students and faculty in most of the cases; found that failure occurred in 63% of the appliances evaluated. Cement loss accounted for 36% of total failure, while breakage and complete loss accounted for 24% and 9% cases respectively. Rajab (2002)⁷ reported 30.7% of the appliances inserted by teaching staff in the Pediatric Dentistry Department at University of Jordan experienced failure over a period of 5 years. Solder breakage accounted for 49.6% of total failure, 32.8% were due to cement loss and 11% due to soft tissue lesions. Tulunoglu *et al* (2005)⁸ recorded 12.7% failure of space maintainers which were inserted by two pediatric dentistry faculty members in the University of Gazi, Turkey, followed up over a period of six years.

The aim of the present retrospective study was to evaluate the performance of space maintainers inserted by male undergraduate students during the

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METHODOLOGY

In King Saud University (College of Dentistry), dental students are trained to insert space maintainers for pediatric dental patients. The procedure is carried out after approval of treatment plan by one of the supervising faculty from the Pediatric Dentistry Division.

The dental records of pediatric dental patients treated by undergraduate male dental students during the academic year 2006-2007 (from September 2006 to July 2007) were reviewed. The children who had at least one fixed or removable space maintainer manufactured during this period were selected for the study. Their parents were contacted and informed about the nature of the study. If the parents agreed, appointment was arranged for a clinical follow-up. The consent form of the College of Dentistry Research Center (CDRC) was signed by parents just before the clinical examination. The following information was recorded on a form especially designed for the study.

- The age and gender of the patient
- Type of space maintainer(s) manufactured
- Date of cementation of the space maintainer (s)
- Arch(s) in which the appliance(s) was/were inserted.
- Current status of the space maintainer(s)

Two interns were trained to perform the follow-up examination which was carried out during December 2008. The follow-up visit started with a full mouth prophylaxis using prophylaxis rubber cup and paste, followed-up by determining status of the space maintainer by both the examiners. At the end of the visit, topical fluoride was applied. If the child needed further

dental treatment, an appointment or referral was arranged for him. The status of space maintainer was determined using the criteria described by Rajab 2002⁷ (Table 1).

The collected data were analyzed by using the SPSS (Version 15.0, SPSS Inc., Chicago, IL). Descriptive analysis was carried out first and then the factors that might have any significant association with the status of space maintainer(s) were tested by using Chi-square test. The *p*-value of 0.05 and below was considered significant.

RESULTS

A total of three hundred children were treated in the undergraduate dental clinics during the academic year 2006-2007, of which 103 children had 130 space maintainers manufactured for them. The age ranged from 5 to 11 years with a mean age of 8.4 (±1.39) years. The mean time elapsed between the insertion of the appliance and follow-up examination 19.6(±7.43) months. Fifty nine (57.3 %) children were male and 44 (42.7 %) female.

Of the 130 space maintainers, 64 (49.2%) were bands and loops (B&L), 39 (30.0%) lower lingual holding arches (LLHA), 22 (16.9%) Nance appliances, and 5 (3.9 %) were Transpalatal Appliances (TPA). More than half space maintainers (76: 58.5%) were fitted in mandibular arch and the rest (54: 41.5%) in the maxillary arch. The status of all space maintainers is presented in Table 2. Of the 42 appliances that were considered successful, 10 appliances had been removed and 32 were still in function. About half (48.0%) of the appliances were considered failure while 26 (20.0%) appliances were lost to follow-up. Various causes of appliance failure are reported in Table 3 according to space maintainer type. The most common cause of failure in this study was complete loss of the appliance which was recorded in 44 (71.0%) cases. The second common

TABLE 1: OUTCOME CRITERIA OF SPACE MAINTAINER PERFORMANCE

Successful/removed	The space maintainer accomplished it's primary purpose of placement with successful space management and the appliance was removed
Successful/currently functioning	This category registered either during examination of the child or from dental records
Failure	The space maintainer was intact and still under observation at the termination of the study
Lost to follow up	Any appliances that were removed because of: cement loss, complete loss of the appliance breakage or solder breakage, soft tissue lesion interference with eruption of the permanent teeth
	Any appliance lost to follow up with unknown status because the patient failed to attend the recall visit.

TABLE 2: STATUS OF THE SPACE MAINTAINERS

Status of SM	Types of space maintainers				Total
	B & L	LLHA	Nance	TPA	
Successful/removed	4	4	2	0	10(7.7 %)
Successful/currently functioning	19	5	6	2	32(24.6 %)
Failure	33	22	6	1	62(47.7 %)
Lost to follow-up	8	8	8	2	26(20.0 %)
Total	64 (49.2 %)	39(30.0%)	22 (16.9 %)	5 (3.9 %)	130(100.0%)

B&L: Band and loop; LLHA: Lower lingual holding arch; TPA: Transpalatal arch

TABLE 3: CAUSES OF FAILURE FOR SPACE MAINTAINERS

Reasons of failure	Types of space maintainers				Total
	Band & loop	LLHA	Nance	TPA	
Complete lost	23	15	5	1	44(71.0 %)
Breakage	2	3	1	0	6(9.7 %)
Cement lost	3	2	0	0	5(8.1 %)
Soft tissue lesion	3	1	0	0	4(6.5 %)
Interfere with eruption	2	1	0	0	3(4.8 %)
Total	33 (53.2%)	22(35.5%)	6 (9.7%)	1 (1.6%)	62(100.0%)

B&L: Band and loop; LLHA: Lower lingual holding arch; TPA: Transpalatal arch

cause of failure was breakage of the appliance followed by failure of cementation which constituted 9.7% and 8.1% of the cases respectively. Failures related to soft tissue lesions and interference with eruption of permanent teeth comprised about 11% of failure cases.

There was no significant ($p>0.05$) association between space maintainers' status and age group of the child (less than 9 years old and 9 years or older), gender, arch type and type of space maintainer(s).

DISCUSSION

Many authors have discussed the indications, contraindications and considerations for the use of space maintainers, but little evidence exists regarding their performance.^{1-3, 9} Therefore, the present study adds to the information about performance of space maintainers inserted by undergraduate students.

In previous studies, use of removable space maintainer varied from 8% in one study⁷ to over 60% in another study⁸. The limited use of removable space maintainers in the present study could be attributed to lack of retention, possibility of choking and high compliance required from the child. Distal shoe was not inserted by dental students in this study as also reported by previous studies.^{5,7} The reason could be the difficulty of insertion of distal shoe and the possible infection associated with it.² Band and loop was the most commonly used space maintainer in this study followed by LLHA which is in agreement with several previous reports.⁵⁻⁷

One fifth of the patients were in the "lost to follow-up" group in this study, which is similar to the percentages reported by other studies.⁶⁻⁷ In contrast, Tulunoglu *et al.*⁸ reported over 50% of the appliance lost to follow-up in their study; the high rate was attributed to length of the follow-up period (over 6 years) and a negative attitude of parents toward recall visits.

The failure rate found in this study (47.7%) was similar to the 43% rate reported by Hill *et al.*⁴ where 191 children (6-10 years old) were followed for 4 years. These failure rates were low in comparison to the failure rates of 63% reported by Qudeimat and Fayle⁶ who attributed the high rates to wider age range of patients (3.4 to 22.1 years) and long follow-up period (5 years). In contrast, Rajab⁷ and Baroni *et al.*⁵ reported low failure rates. The former reported a failure rate of 30.7% in 358 children 4 to 9 years old followed for 5 years; and the latter 30.5% in 61 children 5-9 years old followed for a maximum of 53 months. However, both the studies were carried out in university based clinics under the care of teaching staff in pediatric dentistry department who inserted the space maintainers and recalled the patients every 6 months. Tulunoglu *et al.*⁸ reported the lowest failure rate (12.7%) of space maintainer, however, 52% of the cases were lost to follow-up and the failure rate in this group could not be determined.

The most common failure in the present study was complete lost of the appliance, which represented 71% of the total failure. This finding is comparable to the

result of Hill *et al*⁴ where appliance loss was also the most common cause of failure, however this constituted only 37% of the total failure in their study. The percentage of complete loss was much higher than the 6% reported by Qudeimat and Fayle⁶ where over 80% of the appliances were inserted by postgraduate students and university staff. Nevertheless, several studies did not report any loss of the fixed space maintainers.^{5,7,8} The complete loss of space maintainers could be related to fabrication/insertion errors or poor patient's compliance. However, complete loss of the appliance could be avoided if there was close supervision of the students during band selection, insertion of the appliances and close follow-up to ascertain optimum performance of the appliance and if there was any problem related to it.

The second common cause of failure was breakage of the appliance which accounted for about 10% of total failures in this study; which was lower than the 50%⁷, 37%⁵, 27%⁴ and 23%⁶ breakage failure rates reported for fixed space maintainers in previous studies. Baroni *et al*⁵ concluded that the mechanical stress on the appliance in long-term seems to be more important than the appliance design in this regard. Other investigators attributed breakage to poor quality of construction which include incomplete soldering of joints, overheating of the wire during soldering, over thinning of the wire during polishing, remnants of flux on the wire and failure to encase the wire in the solder.^{4,10,11}

Other cause of space maintainer failure was cement loss which accounted for 8% of total failures in this study. This rate was lower than the 14%⁴, 32%⁷, 33%⁵ and 36%⁶ cement failure rates reported in fixed space maintainers by previous studies. The cement loss could be related to poorly adapted bands or difficulties in keeping a dry field during cementation especially in case of bilateral appliances.^{4-6,10}

Soft-tissue lesion resulting from space maintainers is often referred to as impingement. In the present study, soft tissue lesions were recorded in 6.5% of failed cases, which was lower than 9%^{6,7} and 19%⁵ soft tissue pathology reported previously. In the present study, 4.8% space maintainers interfered with eruption of permanent teeth. Other studies also have reported similar^{6,7} or slightly higher (11%) rates⁵.

The age and gender of children, and arch type had no significant association with performance of the space maintainer, in agreement with several previous studies.⁵⁻⁸ However, the previous studies which focused on the longevity of space maintainers and assessed the effect of different variables to the survival time of the appliances.⁵⁻⁸ They used the life table method to measure the median survival time of various space maintainers. The present study was not longitu-

dinal, therefore, it could not report the exact time of failure nor the longevity of space maintainer over a period of time.

CONCLUSIONS

- The overall performance of the space maintainers can be summarized as 32.3% successful, 20.0% lost to follow-up and 47.7% failed.
- The most common cause of space maintainer failure was complete loss of the appliance, followed by breakage and cements loss.
- Age & gender of the child and, arch type had no significant ($p>0.05$) association with the performance of the space maintainers.

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