

INTRODUCTION AND BACKGROUND

Early or premature loss of a primary tooth is defined by the loss of said tooth in the time before natural exfoliation is expected. [1] The most common reason for premature loss of primary teeth is dental caries. [1] Other causes of premature loss may include dentoalveolar trauma, ectopic eruption of successor teeth, and congenital disorders. Premature loss of primary teeth, if left untreated, may result in space loss, drifting and/or tipping of adjacent teeth, crowding of the dentition, possible impaction of successor teeth and malocclusion.

The loss of space occurs within the first 4 to 6 months after early loss of primary first molars. Distal drifting of primary canine and max incisors after early loss of the first primary molar causes decrease in D+ E space. [12] There is high probability of space loss, with greater loss of arch length in the maxilla than in the mandible for loss of second molar. [13] Space maintainer appliances (SMA) are indicated to maintain the space created by premature loss of primary teeth and when utilized successfully, may avoid space loss and other negative sequelae.

SMAs can be designed as fixed or removable types. Fixed SMAs are cemented onto abutment teeth and cannot be removed by the patient. Fixed SMA types include the band and loop, lower lingual holding arch, distal shoe, Nance retainer, and transpalatal arch. Band and loop SMAs are one of the most frequently utilized appliances for patients requiring single tooth space maintenance in both primary and mixed dentitions. [4] It preserves the proximal dimensions, while remaining passive and should not cause unintended tooth movement. [4]

Although its use is largely beneficial, an adverse effect of fixed SMAs is increased plaque accumulation, which can lead to demineralization of the enamel and increased development of caries. [5, 6] Because band and loop appliances cannot be removed by the patient and have plaque-retentive sites, there can be difficulty maintaining optimal oral hygiene which results in an increase in the number of microorganisms. [5] Arian et al. (2007) reports a statistically significant increase in cariogenic salivary microflora such as *Streptococcus mutans* and *Lactobacillus* counts 3 months after the placement of fixed SMAs. [9, 10] Additionally, the insertion of these appliances may cause a decrease in pH, buffering capacity, and salivary flow rate in the oral environment. [11]

PURPOSE AND OBJECTIVES

The purpose of this study was to evaluate the incidence of caries after placement of fixed band and loop SMAs, compared to the contralateral side of the arch without SMAs.

The objectives of this study were to 1) determine if the placement of a fixed SMA increased caries incidence of the banded, adjacent and looped teeth as compared to the contralateral side, 2) determine if other factors, such as the type (chairside or lab fabricated), location (maxillary or mandibular), and oral hygiene, contributed to the incidence of future caries on the banded, adjacent and looped teeth.

STUDY DESIGNS AND METHODS

This study was a retrospective chart review of patients who received a fixed band and loop SMA from the Division of Pediatric Dentistry at Montefiore Medical Center between the time period of July 2018 to June 2021. Study personnel collected data from the electronic dental records of patients who met the inclusion/exclusion criteria. Records reviewed included clinical treatment notes, radiographs, and ADA billing codes for SMAs. Personal identifiers were excluded during data collection, therefore there were minimal risks to the participants. Inclusion/exclusion criteria were a complete record of the SMA procedure, as well as diagnostic pre-treatment radiographs of the treated and contralateral quadrants. Additionally, all participants must have had at least one follow-up visit which included a clinical exam note and/or diagnostic post-treatment radiographs of the treated and contralateral quadrants.

RESULTS

A total of 564 patient charts were reviewed, of which 121 met the established inclusion/exclusion criteria. All space maintainers placed during the study period were laboratory-fabricated. At the follow-up visit, the total number of new caries across all patients was 33. New carious lesions were noted in three distinct locations: on the banded tooth, on the tooth adjacent to the band, and on the tooth contacting the loop. A greater number of new carious lesions were identified on the contralateral side (n=22, 19.8%) than on the SMA treatment side (n=11, 9.1%). Four patients had new caries on both the contralateral side and SMA treatment side.

Among the 121 qualifying cases, 71 space maintainers were placed in the mandibular arch and 50 in the maxillary arch. When calculated by arch, the mandibular arch presented with 8 new carious lesions on the SMA treatment side and 16 on the contralateral side. In the maxillary arch, 3 new carious lesions were observed on the SMA treatment side, compared to 6 on the contralateral side. Carious lesions were further subdivided into location: Banded, Adjacent and Looped. In the maxillary arch, the SMA treatment side yielded 1 Banded, 0 Adjacent, and 2 Looped caries, while the contralateral side yielded 2 Banded, 2 Adjacent, and 2 looped caries (Figure 1). In the mandibular arch, the SMA treatment sided yielded 2 Banded, 4 Adjacent, and 2 Looped caries, while the contralateral side yielded 5 Banded, 6 Looped, and 5 Adjacent caries (Figure 2).

In patients with complete oral hygiene (OH) documentation, OH was categorized into no change from pre-SMA placement to post-SMA placement, worsened, or improved. The distribution of caries, both on the SMA treatment side and contralateral side, among OH categories was largely uniform (Figure 3).

ACKNOWLEDGEMENTS

Thank you to Abdissa Negassa, PhD for his statistical analysis of study data

RESULTS

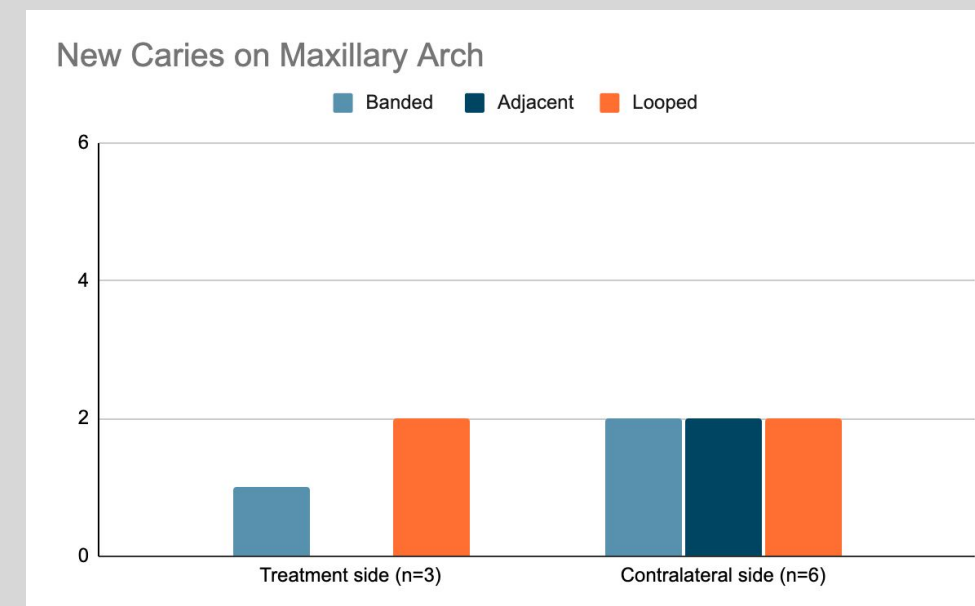


Figure 1. New caries on Maxillary Arch

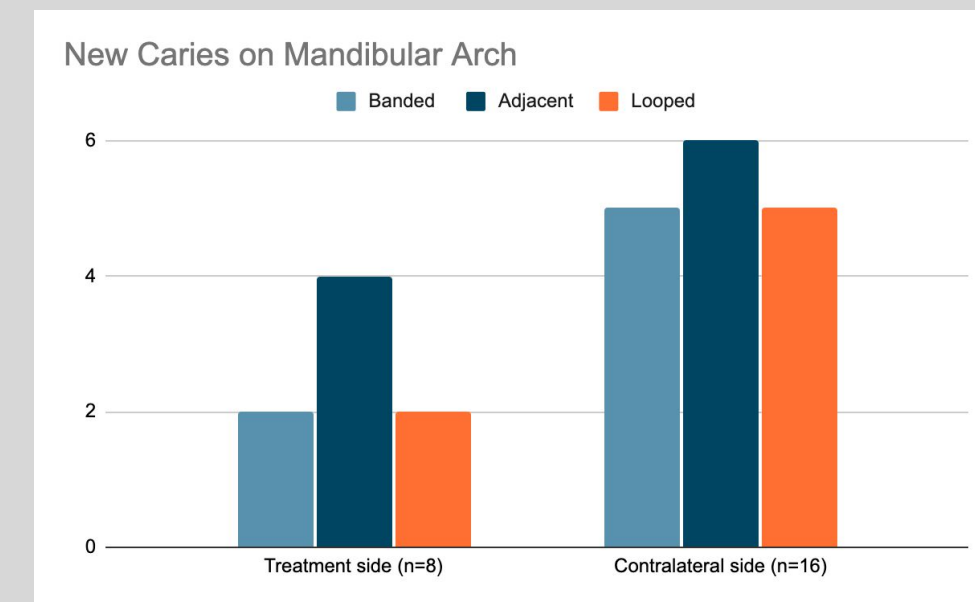


Figure 2. New caries on Mandibular Arch

RESULTS

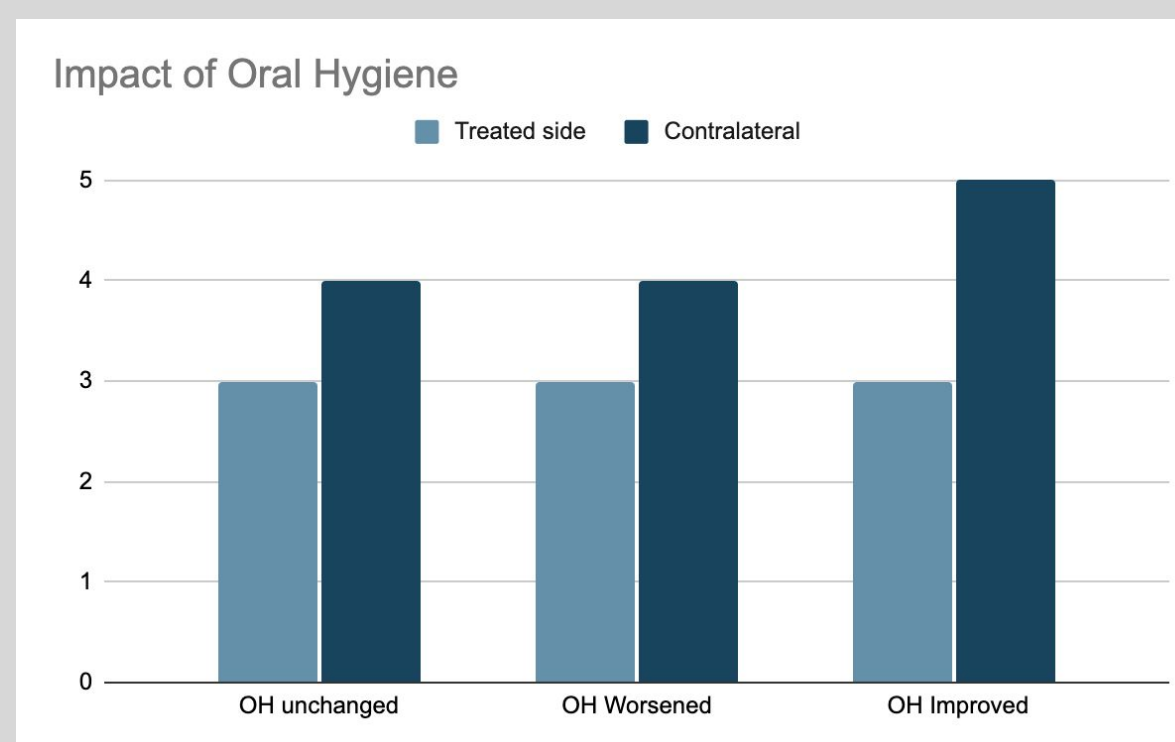


Figure 3. Impact of Oral Hygiene

DISCUSSION

This study demonstrated that the overall incidence of caries following space maintainer placement was low, occurring in less than 25% of study participants, despite the fact that all patients were inherently high-risk, as evidenced by their need for extractions and space maintenance.

While the mandibular arch yielded a new caries rate greater than the maxillary arch (33.8% vs 18.0%) with differing distribution patterns, neither arch location nor oral hygiene status emerged as significant factors influencing caries development. Furthermore, there was no evidence of effect modification by location ($p > 0.9$), although a more robust assessment would require a larger sample size. After adjusting for location, no significant association was observed between space maintainer use and caries incidence ($p = 0.2$).

Most importantly, the similar caries incidence between SMA treated and contralateral untreated sides suggested that space maintainers do not increase caries risk. Overall, the findings supported the continued use of band and loop space maintainers as an effective and safe space management solution in pediatric dentistry, even among children already predisposed to dental decay.

REFERENCES

1. Brothwell DJ. Guidelines on the use of space maintainers following premature loss of primary teeth. J Can Dent Assoc. 1997;63:753-757-60,764-6.
2. Bansal M, Gupta N, Gupta P, Arora V, Thakar S. Reasons for extraction in primary teeth among 5-12 years school children in Haryana, India- A cross-sectional study. J Clin Exp Dent. 2017 Apr 1;9(4):e545-e549. doi: 10.4317/jced.53076. PMID: 28469820; PMCID: PMC5410675.
3. Setia V, Pandit IK, Srivastava N, Guagnani N, Sekhon HK. Space maintainers in dentistry: past to present. J Clin Diagn Res. 2013 Oct;7(10):2402-5. doi: 10.7860/JCDR/2013/6604.3539. Epub 2013 Oct 5. PMID: 24298544; PMCID: PMC3843386.
4. Vinothini V, Sanguida A, Selvalalaji A, Prathima GS, Kavitha M. Functional Band and Loop Space Maintainers in Children. Case Rep Dent. 2019 Apr 24;2019:4312049. doi: 10.1155/2019/4312049. PMID: 31179132; PMCID: PMC6507256.
5. Arian F, Eronat N, Candan U, Boyacioglu H. Periodontal conditions associated with space maintainers following two different dental health education techniques. J Clin Pediatr Dent. 2007 Summer;31(4):229-34. doi: 10.17796/jcpd.31.4.9588m43n027i560n. PMID: 19161056.
6. Arendorf T, Addy M. Candidal carriage and plaque distribution before, during and after removable orthodontic appliance therapy. J Clin Periodontol. 1985 May;12(5):360-8. doi: 10.1111/j.1600-051x.1985.tb00926.x. PMID: 3859496.
7. Alaluusua S, Malmivirta R. Early plaque accumulation--a sign for caries risk in young children. Community Dent Oral Epidemiol. 1994 Oct;22(5 Pt 1):273-6. doi: 10.1111/j.1600-0528.1994.tb02049.x. PMID: 7813174.
8. Bahurupi, Mayuri Prabhakar; Gupte, Tejashri Shreyas; Grace, Bridget; Sawant, Ameysa Shridhar; Sonawane, Nilam Subhash. Comparative evaluation of changes in salivary flow rate, pH, and Streptococcus mutans levels in children undergoing fixed and removable space maintainer therapy. Journal of Indian Society of Pedodontics and Preventive Dentistry 40(4):p 404-409, Oct-Dec 2022. | DOI: 10.4103/jisppd.jisppd_439_22
9. Patidar, Deepika; Sogi, Suma; Singh, Varsha1; Shinu, P1; Loomba, Ashish; Patidar, Dinesh C2. Salivary levels of Streptococcus mutans and Streptococcus sanguinis in early childhood caries: An in vivo study. Journal of Indian Society of Pedodontics and Preventive Dentistry 36(4):p 386-390, Oct-Dec 2018. | DOI: 10.4103/JISPPD.JISPPD_204_18
10. El-Patal, Mohamed Abd-Elattif1,2; Asiry, Moshabab A3; AlShahrani, Ibrahim4; Bayoumy, Samy Youssef El5; Wakwak, Mohammed Abo-Elkasem Ahmed6; Khalil, Mona Abdelghafar Mohamed7. The effect of fiber-reinforced composite versus band and loop space maintainers on oral Lactobacillus acidophilus and Streptococcus mutans levels in saliva. Journal of Indian Society of Pedodontics and Preventive Dentistry 36(3):p 301-307, Jul-Sep 2018. | DOI: 10.4103/JISPPD.JISPPD_155_18
11. Kundu, Ritesh; Tripathi, Abhay M.; Jaiswal, Jagdish Narain; Ghoshal, Ujjala1; Palit, Madhuchanda; Khanduja, Sonali1. Effect of fixed space maintainers and removable appliances on oral microflora in children: An in vivo study. Journal of Indian Society of Pedodontics and Preventive Dentistry 34(1):p 3-9, Jan-Mar 2016. | DOI: 10.4103/0970-4388.175498
12. Lin YT, Lin WH, Lin YT. Immediate and six-month space changes after premature loss of a primary maxillary first molar. J Am Dent Assoc. 2007 Mar;138(3):362-8. doi: 10.14219/jada.archive.2007.0169. PMID: 17332042.
13. Lucas-Rincón SE, Robles-Bermeo NL, Lara-Carrillo E, Scougall-Vilchis RJ, Pontigo-Loyola AP, Rueda-Ibarra V, Loyola-Rodríguez JP, Escoffié-Ramírez M, Medina-Solis CE. Interproximal caries and premature tooth loss in primary dentition as risk factors for loss of space in the posterior sector: A cross-sectional study. Medicine (Baltimore). 2019 Mar;98(11):e14875. doi: 10.1097/MD.00000000000014875. PMID: 30882692; PMCID: PMC6426507.