

Prevalence of Lingual Arch Space Maintainer among Children between the Age Groups Of 6-10 Years - A Retrospective Study

Research Article

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Abstract

In 1887, Davenport described space loss resulting from premature loss of deciduous teeth. The causes for tooth loss can be deep dental caries, trauma or iatrogenic damage, and congenital absence. About 51% of the prematurely lost first deciduous molars and 70% of prematurely lost second deciduous molars cause loss of space and subsequent effects such as malposition or impaction of a permanent tooth in that quadrant, tipping of the first permanent molar, and crowding in the dental arch. Space maintenance in the developing dentition can prevent unnecessary loss of arch length. Various space maintainers have been used to cope with these problems. This study aims to assess the prevalence of Lingual Arch Space Maintainer among children between the age group of 6-10 years. A retrospective cross-sectional study was conducted using the patient records from the Department of Pedodontics, Saveetha Dental College, Chennai from June 2019-April 2020, and children who underwent space maintainer therapy were collected by Non-probability sampling. Data was collected and then subjected to statistical analysis. A total of 14 children were subjected to space management therapy using lingual arch space maintainer, out of this children of 9 years of age were predominantly exposed to lingual arch space maintainers, followed by 7 year old children. More males underwent lingual arch space maintainer therapy in comparison to females. The prevalence of lingual arch space maintainer among the mixed dentition phase in this study was higher when compared to prior studies that state that lingual arch space maintainer was not indicated among the specified age groups. Considering the previously stated limitations of the lingual arch space maintainer, extensive research regarding newer alternatives for space maintenance is to be carried out and awareness among dentists regarding the necessity for further such advancements is mandatory.

Keywords: Preventive Orthodontics; Space Maintainer; Lingual Arch Appliance; Mixed Dentition; Premature Loss.

Introduction

Premature loss of primary molars often causes undesirable drifting and loss of space [1]. In 1887, Davenport described space loss resulting from premature loss of deciduous teeth. The causes for tooth loss can be deep dental caries, trauma or iatrogenic damage, and congenital absence [2]. About 51% of the prematurely lost first deciduous molars and 70% of prematurely lost second deciduous molars cause loss of space and subsequent effects such as malposition or impaction of a permanent tooth in that quadrant, tipping of the first permanent molar, and crowding in the dental arch [3, 4]. Space maintenance in the developing dentition

can prevent unnecessary loss of arch length. Various space maintainers have been used to cope with these problems. They are indicated for loss of at least one deciduous tooth, loss of arch perimeter, or a favorable prediction from the space analysis if it can be completed [5].

Space maintainers are fixed or removable appliances used to preserve arch length following the premature loss or elective extraction of a tooth/teeth. Retained primary teeth can also act as space maintainers [6]. The primary dentition plays a very important role in the child's growth and development, not only in terms of speech, chewing, appearance and the prevention of bad habits but also in the guidance and eruption of permanent teeth [7-9].

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Exfoliation of primary teeth and eruption of permanent teeth is a normal physiological process. When this normal process is disrupted, due to factors like premature loss of primary teeth, proximal carious lesions etc, it may lead to mesial migration of teeth resulting in loss of the arch length which may manifest as malocclusion in permanent dentition in the form of crowding, impaction of permanent teeth, supraeruption of opposing teeth etc [10, 11]. The best way to avoid these problems is to preserve the primary teeth in the arch till their normal time of exfoliation is attained. Hence it is rightly quoted that primary teeth serve as best space maintainers for permanent dentition [12, 13].

Space maintainer appliances are most commonly used to maintain the space created by early loss of a first or second primary molar while awaiting the eruption of its successor [14, 15]. Space management is an important responsibility of clinicians who are involved in monitoring the developing dentition, as the loss of arch length may lead to problems such as crowding, ectopic eruption, dental impaction, crossbite formation, and dental centre line discrepancies. The use of space maintainers may potentially obviate the need for later extractions and/or complex orthodontic treatment [16].

In preventive and interceptive orthodontics, the use of a mandibular fixed lingual appliance (FLA) is a commonly accepted procedure to maintain arch perimeter by preventing mesial tipping or drifting of the mandibular molars. Molar positions are stabilized against the mandibular incisors by the appliance, which also prevents the incisors from tipping lingually [17]. During the transition from the mixed to the permanent dentitions, developmental changes occur in the arch, including even the leeway space. Normally, the first molars move mesially into the leeway space, and arch length decreases. A lingual arch appliance on the mandibular molars is an effective device to maintain arch length by controlling mesial movement of the molars and to prevent the collapse of the mandibular incisors in a lingual direction [18].

Though the lingual arch space maintainer is widely used, it has many limitations such as the use of a lower fixed bilateral lingual arch appliance in the primary dentition is the potential for permanent incisors to erupt later behind the lingual arch wire [19, 20]. As well as the bacterial and food accumulation which leads to inflammation and pain. This study sheds light on the current scenario of Lingual Arch space maintainer as a treatment modality in the early mixed dentition phase by assessing the prevalence of lingual arch space maintainer among children between the age group of 6-10 years in Chennai.

Materials and Methods

Study Design and Setting

This pilot institution based retrospective study examined the records of 100 patients from June 2019-May 2020 undergoing treatment. The approval from the institutional ethics committee was obtained. The sample population included children who underwent lingual arch treatment by means of non probability sampling. Children with mental or physical disability unable to maintain oral hygiene and children with active lesions or systemic illnesses were excluded from the study.

Data Collection

Data was obtained from exclusive patient management software and was used to identify 14 patients out of 100 patients. Data relevant to the study such as Patients unique ID, Name, Age, Sex was recorded. Repeated patient records and incomplete records were excluded. Data was verified by an external reviewer.

Statistical Analysis

Data was recorded in Microsoft Excel 2016 (Microsoft Office 10) and later exported to the SPSS software for Windows (Version 20.0, SPSS Inc, IBM, Chicago Ill., USA) and subjected to statistical analysis. Chi square test was employed with significance level set at $p < 0.005$.

Results and Discussion

The final data consisted of 14 patients in total of Indian origin undergoing lingual arch space maintainer therapy, among the age group of 6-10 years inclusive of both males and females. The mean age was 8.07 +/- 1.141 years.

The age group associated with greatest prevalence of lingual arch space maintainers was 9 years (35.7%, 5 patients), followed by 7 and 8 years. (Table 1) The prevalence of space maintainers among the specified age group was depicted in a histogram. (Figure 1).

71.4% patients out of the 6-10 year olds receiving lingual arch space maintainer therapy were males, thereby depicting a male predominance although the difference between the genders undergoing lingual arch therapy was not statistically significant ($p > 0.05$). (Figure 2).

The data used in this retrospective study was based on the residents of Chennai. Currently, there are not many studies indicating and investigating the prevalence of lingual arch space maintainer as a treatment modality among the children with mixed dentition phase in Chennai. Since all of the data was included without a sorting process, no bias was expected in the selection of patients. The current study aims to shed light on the current scenario of lingual arch as a treatment modality in the early mixed dentition phase, which is the golden time for prevention of mesial tipping of erupting permanent teeth as described in prior studies.

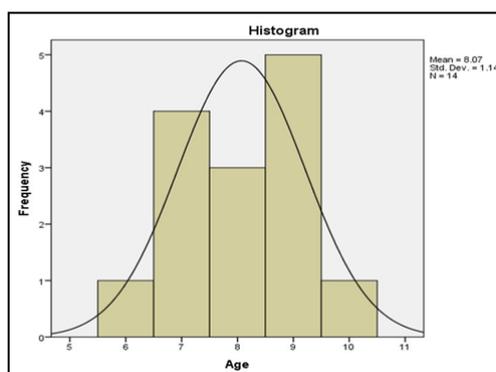
Caries is the most prevalent dental disease both in the primary and the permanent dentition. In a study conducted by Kumar PM et.al, it was concluded that caries rate is high in permanent dentition than in primary dentition and more in children studying in Corporation schools than in Private schools [21]. The reason could be due to the fact that permanent teeth are exposed to a cariogenic diet from the time of eruption till the teeth are in situ. This reinforced the importance of curbing dental caries from childhood so as to ensure proper vitality and integrity of permanent dentition [22, 23].

Early losses of deciduous teeth have often been studied because of their relevance and association with occlusion abnormality, so that in the mixed phase, space maintainers are used to maintain the space corresponding to the permanent successor teeth. The loss of arch length resulting from this process can lead to the

Table 1. This table depicts various age groups of children and the frequency and percentage prevalence of them undergoing lingual arch space maintainer therapy.

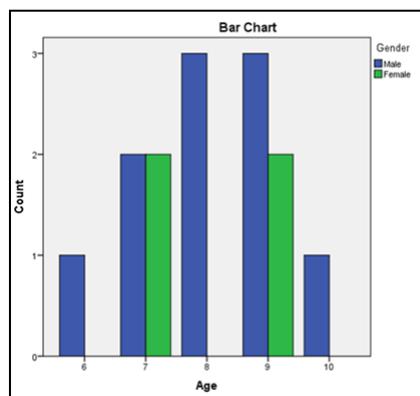
AGE(YRS)	FREQUENCY	PERCENTAGE(%)
6	1	7.1
7	4	28.6
8	3	21.4
9	5	35.7
10	1	7.1

Figure 1. Histogram depicting the various age groups of children and the frequency prevalence of them undergoing lingual arch space maintainer therapy.



Histogram depicting the various age groups of children and the frequency prevalence of them undergoing lingual arch space maintainer therapy. X axis represents the various age groups of the children and the Y axis represents the frequency of undergoing treatment with lingual arch space maintainers. It is observed that the age group associated with greatest prevalence of lingual arch space maintainer was 9 years (35.7%, 5 patients).

Figure 2. Bar graph depicting the association between the gender and the different age groups undergoing treatment using lingual arch space maintainers.



Bar graph depicting the association between the gender and the different age groups undergoing treatment using lingual arch space maintainers. X axis represents the different age groups and Y axis represents the number of male (blue) and female (green) patients undergoing treatment. There was an increase in male patients undergoing lingual arch space maintainer therapy, but this was not statistically significant. (Pearson Chi-square test, $p=0.522$; $p<0.05$; statistically insignificant)

development of several malocclusions in the permanent dentition [24]. The loss of a deciduous tooth is considered to be early or premature when it occurs at least one year before its normal exfoliation or after radiographic evidence that the permanent successor is still short of nolarstage, that is, with coronary formation and root formation not yet started. Several studies have been published regarding the premature loss of deciduous teeth [25, 26].

However, according to a study by Odom et.al, there is a great diversity of opinions about the clinical consequences of premature loss of deciduous teeth, especially regarding the need to use space maintainers [27].

A fixed lingual arch on the mandibular molars is commonly used as a holding device to maintain mandibular arch length and to prevent mesial migration of the mandibular first molars. In preventive and interceptive orthodontics, the use of a mandibular fixed lingual arch is a commonly accepted procedure [28, 29]. It has been used primarily to maintain arch length by controlling the anterior movement of the molars and preventing the collapse of the mandibular incisors in a lingual direction. The effect, if any, the mandibular fixed lingual arch exercises on vertical control of the mandibular molars has not been adequately investigated [30].

Rebellato et al, found that the incisors extruded more than the molars [31]. However, Singer et.al, observed that the molar extru-

sion was greater than that of the incisors [32]. The mandibular fixed lingual arch, as expected, also controlled the mesial movement of the molars and lingual tipping of the incisors. Therefore as the studies conducted by Mershon JV et al., proved the use of a mandibular fixed lingual arch as efficient in preserving arch length [33].

Based on the findings by Brennan et al., it is apparent that the lingual arch appliance placed in the period of early transitional dentition will restrict the mesial migration and use of the leeway space by the molars; therefore, a cusp-to-cusp molar relationship may not self-correct [34]. However, in patients with marginal crowding, a fixed lingual arch is an effective way to control space utilization in the mandibular arch.

From analysing previously conducted studies it was noted that the lingual arch is an effective appliance for maintaining space during the eruption of the permanent teeth, preserving molar anchorage, preventing arch length decrease, obtaining in some patients an arch length increase, and preventing the molars from tipping and the mandibular incisors from tipping lingually [35]. These effects could also resolve marginal crowding by controlling space use in the mandibular arch [36].

This study shows a male predominance towards space management therapy using lingual arch space maintainer which may be due to the predilection of males towards dental caries and dental trauma as well as established by previous literature [37, 38]. This may also be due to the small and limited sample size which thereby sheds light on the requirement for further studies so as to thoroughly analyze the prediction and prevalence of lingual arch therapy.

There is a predominance of children undergoing lingual arch therapy among the age group of 9 years in this study, which may be due to the eruption status in that age thereby cycling back to the fact that lingual arch space maintainers provided during the period of early transitional dentition will restrict the mesial migration and use of the leeway space by the molars, thereby preventing crowding or compromise of arch space and perimeter.

In spite of all the studies contributing to the notion that lingual arch space maintainers are a gold standard for space management therapy, few authors have reported disadvantages of the use of a lingual arch as a space maintainer, including possibility of extrusion of antagonist teeth, when considering the space left by the extracted tooth; non-re-establishment of the masticatory function; and previous history of sensibility to metallic materials. Despite these negative factors, the literature has recommended its use by demonstrating countless advantages that overcome all disadvantages.

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Conclusion

Within the limitations of this institution based retrospective

study, it is observed that lingual arch space maintainers are preferred among children of 9 years of age (35.7%). This leads to the conclusion that the Nance lingual arch helps preserve the leeway space, which is of crucial importance in the transitional period of dentition among children. Its use as a space maintainer was long-term effective, and the small degree of relapse observed is normally expected during the process of occlusion maturation, thereby reinforcing the efficacy of this appliance.

Further studies are to be conducted to eliminate the minor disadvantages and further awareness is to be imparted among dentists so as to aid in better treatment planning protocol in patients so as to ensure proper treatment that ensures the desired results among children.

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