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# A Scoping Review on Design Modifications of Lingual Holing Arch appliance

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**Abstract**

**Background:** Lingual holding arch appliance has been the most trusted space maintainer in the field of pediatric dentistry. This study put forward mapping of application of various designs of lingual holding arch appliance and to verify the main gap in the research on this field.

**Methods:** This is a scoping review that took place in 2021 following PRISMA-ScR Guideline. Data was searched through the database PubMed, SCOPUS, Google scholar The search strategy included keywords' bilateral fixed space maintainer' 'space maintainer' 'lower lingual holding arch' 'fixed lingual arch appliance' 'functional lingual arch holding appliance' A total of eleven studies from nine hundred and thirty original articles were identified and were included and reviewed. The study selection and tabulation of data were performed by two independent reviewers. Any disagreement in study selection was resolved by a third reviewer.

**Conclusion:** In the transitional phase, preventive and interceptive orthodontic plays a significant role in minimizing the inevitable developing malocclusion The mapping determined all proposed designs for the prevention of space loss. Each design needs to be carefully selected based on the phase of mixed dentition. This paper provides information on various designs of a lingual arch space maintainer, and it can be concluded that there is a necessity for long-term follow-up studies for further research in the field.

**Keywords:** space maintainer, space regainer, lingual holding arch in mixed dentition, bilateral fixed space maintainer

## Introduction

The primary dentition not only helps in chewing, esthetic, phonetics, jaw, and muscle growth but also maintains the dental arch until the permanent teeth come to play their role. The ideal occlusion in primary teeth consists of spacing, primate space, and flush terminal plane. Primary dentition in certain clinical situations requires early intervention to enhance dental, alveolar, and musculoskeletal development. The early intervention can be either preventive or interceptive.

The interceptive orthodontic provides a prompt treatment that intervenes in the developing malocclusion. Approximately 14-49% of primary dentition gain benefit from the interceptive orthodontic treatment modalities.[1]( Ngan P, Alkire RG, Fields H Jr. 1999) In mixed dentition, over-retained teeth are related to delay or ectopic eruption

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of the successor, hence the extraction at the earliest is a must.( Bishara SE, Staley RV1987) In the early mixed dentition phase, premature loss of primary first molar, before 7.5 years of age causes a minor transient space loss. [3](Padma Kumari B, Retnakumari N 2006) It is usually compensated by the eruption of the successor's teeth. However, during the eruption of permanent incisors, the primary cuspid drifts distally due to eruption force and contributes to space loss. [4](O A Cuoghi et al 1998) Similarly, premature loss of the second primary molar at the same age causes the permanent first molar to drift in a mesial direction that contributes to permanent space loss.[5-6] (Northway WM, Wainright RW1980, Northway WM, Wainright RL, Demirjin A. 1984)

Space management is a technique through which the available space is either maintained or insufficient space is converted into sufficient space for successors using a fixed or removable appliance.[7] (Foley T, Wright GZ, Weinbergr SJ. 1996) This is brought about by fabrication of space maintaining or regaining appliances depending upon the requirement of space using mixed dentition analysis.[8-10] ( Bishara SE, Staley RN. 1984, Tanaka MM, Johnston LE. 1974, Wright GZ, Kennedy DB 1978) The space maintainer, as the name suggests, maintains adequate space for the successor within the arch.[11-12] (Gianelly AA 1995, Brothwell DJ 1997)

The passive lingual arch appliance is made case-specific appliance about the clinical situation. Every case is unique and based on the clinical situation various modifications are put forth by many authors. The present review aims to compile the data of the various medication of lingual arch appliance in one article so that it's useful for the practitioner and students to gain knowledge and apply it in their practice.

## Methodology

### Study Protocol

The study protocol was prepared before conducting the study and the protocol was made using PRISMA-ScR guidelines. The study was conducted under the following headings–the aim of the study, search strategy, eligibility criteria, and data summary.

## Inclusion Criteria

Any in-vivo study, clinical trial, a systematic review with or without meta-analysis, umbrella review, narrative review, addressing the modifications of space maintainer in mixed and early permanent dentition were included in the scoping review.

## Exclusion Criteria

Studies with no keywords, remarks, and articles in languages other than English were excluded from the review.

## Database Search Strategy

A search strategy was performed using keywords related to the lingual arch appliance. Data was searched through the database PubMed, SCOPUS, Google scholar until 17 September 2021. The search strategy included keywords' bilateral fixed space maintainer' 'space maintainer' 'lower lingual holding arch' 'fixed lingual arch appliance' 'functional lingual arch holding appliance'. Further articles were hand searched for inclusion criteria. The English language article that fulfilled the inclusion criteria addressing the modifications done in the lingual holding arch appliance was eligible for inclusion. This search yields 11 studies to be included in the review.

## Study Selection and Data Tabulating

The peer-reviewed articles that fulfilled the inclusion or exclusion criteria, addressing lingual arch space maintainer were eligible for inclusion. The basis for final inclusion was—Population-(any)-concept-(lingual arch space maintainer)-context- (interceptive treatment). There were no specific primary or secondary outcome measures described for the review. The study selection and tabulation of data were performed by two independent reviewers (MM and TL). Any disagreement in study selection was resolved by a third reviewer (MP). While tabulating the data, the variables drawn out were author (year), study design, location, objectives, results, conclusion, and limitations.

## Result

### Evidence Selection

In the evidence-based selection of the present review, 930 articles were identified from the database and 6 were through the manual search were identified. Out of 936, 53 articles were not related to fixed

lingual holding appliances and were excluded from the study. Following duplication, 74 articles were screened for the title and abstract content. Full text 22 articles were reviewed for eligibility assessment and finally, 11 articles were included in the review based on inclusion criteria.

**Evidence Insights on Lingual Arch Space Maintainer**

The included articles are further divided into the following sub-categories based on their usage in the mixed dentition period.

1. Lingual holding arch space maintainer in Early mixed dentition
2. Lingual holding arch space maintainer in the Transition period
3. Lingual holding arch space maintainer/space regainer in the late mixed dentition:

**Figure 1: Shows lingual holding arch modified with canine spur**

**Figure 5: Shows lingual holding arch modifies to preserve space of congenitally missing premolar**

**Figure 2: Shows fixed functional lingual holding arch**

**Figure 3: Shows semificxed functional space maintainer**

**Figure 4: Shows Ligual arch holding appliance with open coil space regainer.**

## Discussion

In the transitional phase preventive and interceptive orthodontic plays a significant role in minimizing the inevitable developing malocclusion. The principle behind this is maintaining the leeway space of 3.4mm in the upper arch and 1.8mm in the lower arch. In the mandible, a fixed passive lingual holding arch appliance is used for the same. The appliance posteriorly rests passively on the lingual surface of banded the first permanent molar and anteriorly 1mm away from the cingulum of permanent incisors. Thus, provide very little soft tissue irritation. The main drawback of the appliance is no chair-side manipulation is possible once it is soldered.

## 1. Lingual holding arch space maintainer in Early mixed dentition

### Modified Anterior Segment of LLA

In the early mixed dentition stage, permanent incisors and first permanent molars are in the passive eruptive phase until the occlusion is established. The ideal protocol for the extension of the anterior segment of the lingual holding arch appliance is from distal of 72 to distal of 82. The appliance does not interfere with the eruption of the lateral incisor and prevents midline shift by maintaining its position. The drawback is the difficulty faced at chair-side manipulation and the appliance has to be replaced by a conventional fixed passive lower lingual holding arch appliance after the complete eruption of both lateral incisors .13 (Dugoni SA 1995)

### Modified Posterior segment of LLA

The fixed passive lower lingual holding arch appliance with an omega loop in the posterior segment brings upon the correction to a certain extent. The omega loop is positioned close to the mesial aspect of the first permanent molar at the level of the second primary molar. The omega loop helps in chair-side manipulation. However, the activation of the appliance by opening omega loop facilitates lingual tipping of anterior and distal tipping of molar to a certain level thereby correcting minor discrepancy in the occlusion.14 (Kiran D.P 2015)

### Modified Anterior and Posterior Segment of LLA

In the early mixed dentition phase, premature loss of bilateral primary molar contributes to minor space loss whereas the passive eruptive force of lateral incisor exerts unwanted distal drifting of primary cuspid subsequently changing midline. Anteriorly, the canine spur is incorporated in the disto-cervical aspect of the primary cuspid thereby engaging the tooth in the bucco-cervical undercut. It provides stability for the primary cuspid and maintains the midline. In the posterior segment, the addition of the omega loop facilitates chair-side manipulation. In the absence of anterior crowding and the presence of sufficient anterior space, this appliance is useful. (Figure 1).[13] (Dugoni SA 1995)

## 2. Lingual holding arch space maintainer in a transition period

Early loss of bilateral multiple primary molars before 7 years contributes to the delayed eruption of permanent successors due to overlying bone and thick fibrous mucosa. The long span of the edentulous area can allow supra eruption of opposite teeth, stimulate habitual lateral tongue thrust habit, and improper distribution of masticatory load. The functional [14](Kiran D.P 2015) (Figure 2) and semi-functional[15] (Jonathan PT et al 2017) (Figure 3) fixed lower lingual arch holding appliance contributes to overcoming the above-said problems. The appliance is consisting of artificial teeth with an acrylic base either soldered or acrylic/incorporated in the main unit. The functional unit either rests directly on the alveolar ridge using acrylic base and clasp or indirectly above the soldered wire placed in the edentulous area of the tooth. As the said appliance rest on the alveolar ridge, it stimulates bone loss and eruption of successor due to vertically directed masticatory force. In the presence of a clear acrylic base, the clinical evaluation is made handy and overcome the above-noted problems. The main drawback is the bulky acrylic base and the higher chance of debonding and breakage of the appliance. In multiple replaced teeth, the appliance has to be trimmed multiple times and has to be replaced by a conventional appliance once the entire successor erupts into the oral cavity.[14-15] (Kiran D.P 2015,

The hinge lock system is incorporated in between functional and non-functional units. It uses a buccal

and lingual molar tube in the acrylic base on the buccal and lingual flange and a 0.64nm locking wire made to pass through the acr ylic molar tube and rest on the molar tube band of the first permanent molar. This helps in easy removal of the appliance without debanding and allows better visualization on follow-up.[14] ( Chalakkal Pet al 2017; Jonathan PT et al 2017)

### 3. Lingual Holding arch Space Maintainer/ Space Regainer in the late Mixed Dentition

In the presence of a long-standing edentulous arch, the leeway space deficiency related to caries and chronic infection the subsequent loss of proximal tooth structure and eventually early tooth loss. It is either brought upon by mesially drifted first permanent molar, lingually erupted incisor, and decreased anterior arch width or moderate crowding with retroclined lower incisors. The space regaining tool such, open coil spring used by segmental bonding of two adjacent teeth or along with Niti wire to distalize and vertical inclination of first permanent molar and create space by pushing an anterior and posterior segment of the banded tooth away from each other. It also corrects the midline shift in the mixed dentition phase. Another tool is a crossbow with a fixed lower lingual holding arch appliance, the segment is soldered on either side of the banded first permanent molar, and using the open coil spring in the distal segment of the band brings about sufficient space is regained for the successor's teeth.[17] (Chalakka P et al 2012) (Figure 4)

### 4. Combination of space maintainer with habit breaking appliance:

In the presence of para-functional habit related to lower arch, lip bumper along with fixed lower lingual arch holding appliance will additionally intercept lip sucking habit.[18] (De Souza N et al 2018 )

### As Interim Appliance in Case of Congenitally Absent Premolar:

In cases of congenitally missing mandibular premolars, wherein the loss of primary molars is inevitable; LHA with a horizontal loop in the edentulous region can be given. Until all second permanent molars come into occlusion, this will maintain the mesiodistal width for fixed prosthesis options in the future.[19] (Chauhan. A et al 2 019) (Figure 5)

## Conclusion

Based on the findings of the present review, it is concluded that

1. The various designs about different clinical situations have been proposed for the prevention of space loss due to premature loss of deciduous teeth; however, the utilization of the appliance needs to be carefully addressed based on the phase of the mixed dentition period.
2. To our best knowledge, the literature lacks in the long-term follow-ups of clinical studies on modifications of lingual arch holding space maintainers, hence the evidence on their longevity is considered to be weak.

## Clinical Significance

Why this paper is important for pediatric dentists?

1. This paper summarizes the design modifications of the lingual arch space maintainer.
2. It discusses the case appropriate design selection of space maintainers. Patient evaluation for oral hygiene, caries risk assessment, and space analysis, and finally patient compliance are the important parameter to be considered for the success of the space maintaining the appliance.
3. Although it provides information on various designs of a lingual arch space maintainer, there appears a necessity for long-term follow-up studies for further research in the field.

**Ethical clearance -** The article is a Scoping review, thus Ethical clearance was not taken for the research.

**Source of funding -** Self

**Conflict of Interest –** NIL

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