

# Modified Distal Shoe Appliance for Bilateral Early Loss of Primary Molars: Report of Four Cases

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## Abstract

**Introduction:** Space maintenance in primary dentition in patients with early loss of several primary molars is a clinical challenge for pedodontists. In these cases, the conventional distal shoe appliance cannot be used and the efficacy of removable appliances is questionable. Thus, appliances with special designs providing increased patient acceptance and optimal efficacy are required in these cases.

**Case Reports:** In this article, we report the successful use of modified distal shoe appliance in a number of patients who suffered from a bilateral early loss of primary molars. In this design, a fixed bilateral appliance was fabricated and incorporated with a distal extension of a conventional distal shoe appliance. A removable appliance was replaced the modified distal shoe appliance as soon as the first permanent molars erupt.

**Conclusion:** The use of a modified distal shoe appliance seems to be a good choice for space maintenance in patients with bilateral loss of primary molars.

**Key Words:** Space Maintenance, Pediatric Dentistry, Tooth Extraction

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## Introduction

Preserving the primary teeth in the dental arch until their exfoliation is one of the most important topics in pediatric dentistry [1]. However, early loss of primary teeth is inevitable in the case of extensive dental caries or trauma [2]. About 51 percent of the premature loss of primary first molars and 70 percent of the premature loss of primary second molars may result in space loss and malpositioning of permanent teeth [3]. It has been shown that early loss of primary second molars and the absence of their eruption guidance for erupting permanent molars may result in a great reduction of arch length which can be more than 8mm in each maxillary quadrant and about 6-4mm in each

mandibular quadrant [4]. Therefore, in the case of early loss of primary molars, and in order to prevent the space loss and following malocclusion developments, the use of space maintainers must be considered [5].

Different types of space maintainers can be used depending on the patient's stage of dental development, dental arch, missing teeth, age, occlusion, and cooperation [6]. Early loss of primary second molars in primary dentition is a challenge in pediatric dentistry. The selection of appropriate space maintainer in these cases depends on the knowledge and devotion of the practitioner to either of two theories of eruption guidance for the first permanent molars. In the first

theory, the distal crown surface of the second primary molar serves as a guide for the eruption of the permanent first molar. Thus, tissue-inserted distal shoe design is recommended in order to provide the guidance. The second theory states that the first permanent molar erupts in its appropriate position by the guidance of the distal root of the second primary molar. Therefore, the use of tissue-inserted appliance will not be sufficient and there is a need for a distal vertical blade in close contact with the mesial surface of the unerupted first permanent molar [7].

Early loss of the second primary molar before the eruption of the first permanent molar necessitates the use of a specific design of an intra-alveolar space maintainer [8]. The eruption paths of the maxillary and mandibular permanent first molars are not the same. In the upper arch, the molar teeth erupt distally and buccally; whereas, in the mandible, the eruption path is mesially and slightly lingually. With respect to this difference in the path of eruption of maxillary and mandibular molars, special attention must be paid to the design and insertion of the space maintainers [9].

Distal shoe appliance was first introduced by Gerber to guide the eruption of the first permanent molar to its appropriate position in the dental arch [10]. Indications for distal shoe maintainer are early loss or extraction of the second primary molars, extensive root resorption, extensive periapical bone loss before the eruption of the first permanent molars, non-restorable second primary molar due to extensive caries, the ectopic eruption of the first permanent molar and ankylosis of the second primary molar. However, before deciding on placing this appliance, the contraindications must also be taken into account. The contraindications are: the absence of adequate number of abutments (loss of several teeth), inadequate cooperation of the child and/or parents, absence of permanent first molar, systemic diseases which affect wound healing process such as diabetes mellitus, and cardiac anomalies that require antibiotic prophylaxis prior to dental procedures [11]. In these conditions, the clinician has two choices; regain the lost space after the first permanent molar erupts, or use a fixed or removable appliance that does not penetrate the tissue nevertheless, applies pressure on the ridge

immediately mesial to the unerupted first permanent molar [4].

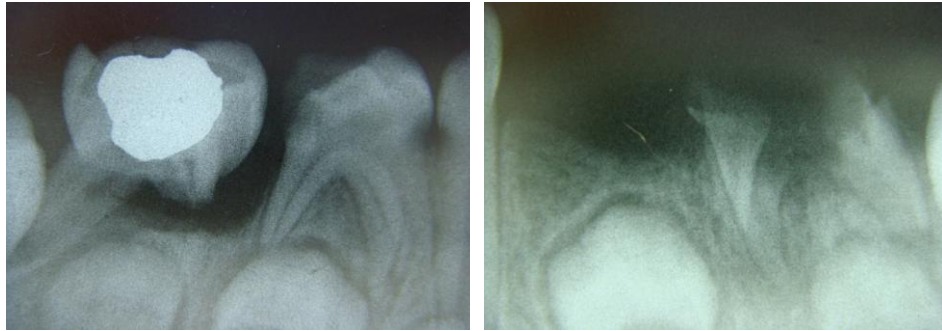
In the case of early loss of several primary molar teeth, the conventional distal shoe appliance cannot be used. The modified distal shoe appliance has recently been the focus of several studies [12-14]. In this case report, we have described some successfully treated cases using modified distal shoe space maintainer. These appliances were simple, effective, and space loss was controlled relatively easy.

### Case Reports

Case 1: A 4.5-year-old girl referred to the Department of Pedodontics of Tehran University of Medical Sciences (29<sup>th</sup> April 2014) with the chief complaints of pain and recurrent abscess formation in the deciduous mandibular molars region of the both sides. Medical history of the patient was unremarkable. Clinical and radiographic examinations revealed that mandibular second primary molars had a hopeless prognosis and needed to be extracted. The primary mandibular left first molar has been previously extracted and the primary mandibular right first molar required pulpotomy (Figure 1). Considering the loss of several primary teeth, conventional distal shoe appliance could not be used. Thus, modified distal shoe appliance was selected for the patient. Parents were briefed on the course of treatment and written informed consent was obtained.

During the preliminary treatments and preparation of the dental arch for the placement of the modified distal shoe space maintainer, the cooperation of the patient and her parents were assessed. Dental treatments were performed as follows: pulpotomy and stainless steel crown (SSC) of primary right first molar, extraction of the primary right second molar, extraction of primary left second molar. Each quadrant was treated in a separate session. After two weeks, suitable bands were fabricated for the primary left canine and primary right first molar by cutting through the line angles and removing the occlusal surface of respective SSCs by a diamond fissure bur. An alginate impression was made and bands were transferred to the impression (Figure 2).

A 0.4-inch orthodontic wire was adapted to the



**Figure 1.** Periapical radiographs of the posterior teeth



**Figure 2.** The fabrication process of a distal shoe appliance, A: appropriate bands for primary mandibular left canine and right primary first molar were selected. B: Bands were transferred to the impression. C: The stone cast were prepared.

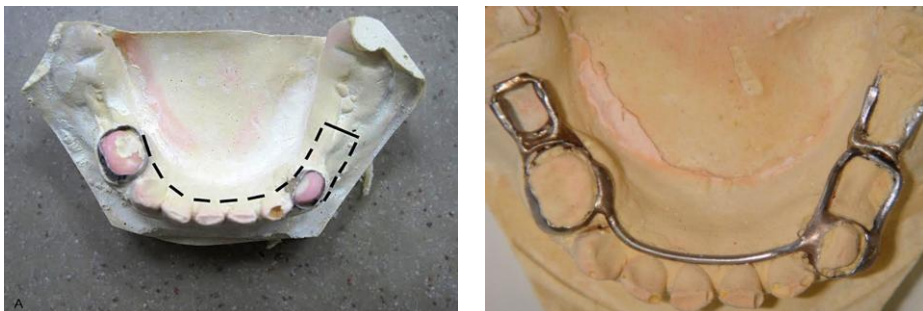
lingual side of the mandibular arch from the primary right first molar to the primary mandibular left canine in order to provide some anchorage. On the left side, the wire was extended distally to the mesiodistal width of the missing first primary molar and soldered to the buccal surface of the canine band at its end (Figure 3). The tubes separated from the Gerber's distal shoe appliance were soldered to the primary right first molar band at one side and to the extension created distal to the primary left canine at the other side. As the result, the fabricated appliance has provided the required anchorage similar to the prefabricated distal shoe appliances. Moreover, it served as a fully adjustable appliance in the clinical setting by moving the distal blade of conventional Gerber distal shoe appliance in the tubes soldered to the modified appliance.

Three weeks later, the appliance was inserted in patient's mouth after administrating local anesthesia and the location of the intra-alveolar blade was adjusted 1mm below the mesial margin

of unerupted first permanent molar (Figure 4). Periapical radiographs were used to control the correct position of the horizontal and vertical extension of the appliance (Figure 5). Finally, the sleeve of Gerber's distal extension was crimped to stabilize the intra-alveolar extension and prevent its displacement.

The appliance was cemented with a zinc polycarboxylate cement (Adhesor Carbofine, Spofa Dental Czech Republic) and the patient was scheduled for one-month follow-ups. In the follow-up sessions, patient and her parents were very cooperative and had no complaint. At 6 weeks following the placement of the appliance, permanent left first molar has erupted and the permanent right first molar was in the process of erupting (Figure 6A).

After one year, with the complete eruption of the first permanent molars, the distal shoe was removed, and the space between the distal surface of the canine to the mesial surface of the first molar was measured bilaterally. Fortunately, no



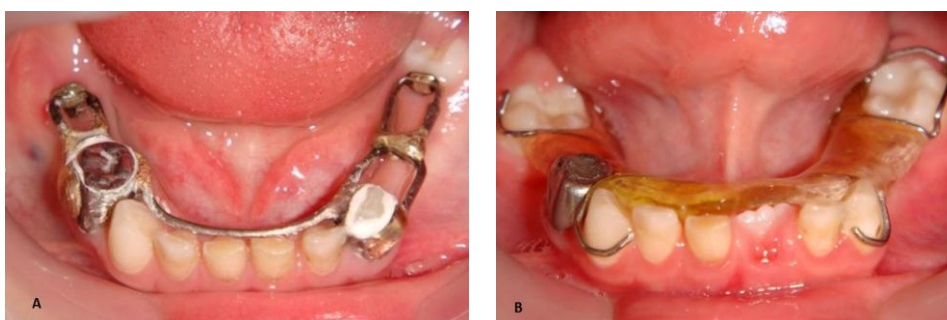
**Figure 3.** (A) Lines indicate the location of wire placement. (B) Distal extension of the adjustable Gerber's distal shoe appliance was soldered to the primary right first molar band and on the left side, was connected to the distal part of the wire extension



**Figure 4.** The appliance immediately after insertion



**Figure 5.** The position of the distal extension was examined using periapical radiographs



**Figure 6. A:** Six months after the placement of the appliance, permanent left first molar appeared in the oral cavity. **B:** Removable space maintainer was fabricated after the eruption of permanent first molars



space loss had occurred. The distal shoe appliance was replaced with a removable appliance in order to preserve the space until the complete eruption of permanent mandibular incisors (Figure 6B). The removable appliance was incorporated with C-clasp on lower primary canines and permanent right first molar and an Adams clasp on the permanent left first molar. An initial carious lesion was developed on the left permanent first molar and was restored using preventive resin restoration technique.

Favorable cooperation of the patient and her parents were guaranteed the use of the removable appliance for the required period of time. A lingual arch space maintainer would be used after the eruption of mandibular incisors.

Our experience with the modified distal shoe appliance is not limited to this case and we have successfully treated a number of similar cases using the same technique as it has been described.

Case 2: A 4.5 years old girl whose primary first

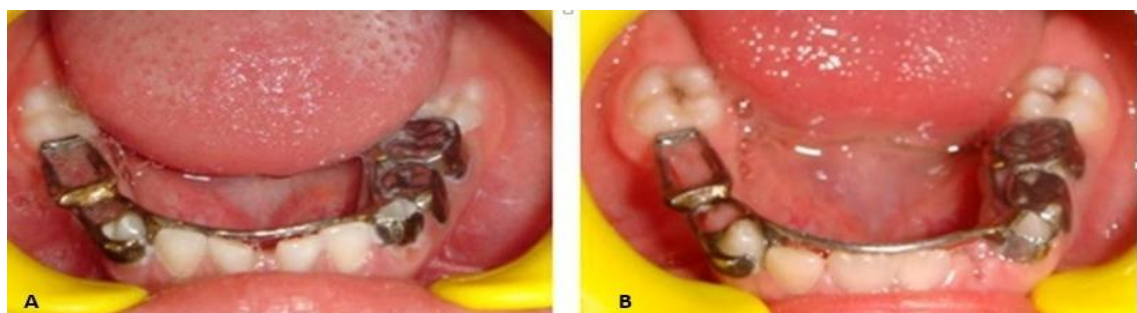
and second molars on the left side of the mandible were extracted, referred to the clinic. A modified distal shoe appliance was designed and fabricated as described earlier. After 2 years, the first permanent molars have fully erupted without any space loss (Figure 7).

Case 3: A modified-distal shoe appliance was designed and cemented for a 5 years old girl suffering from early loss of first and second primary molars on the right side of the lower arch. After a year, the first permanent molars have fully erupted in their position with the guidance of intra-alveolar blade (Figure 8).

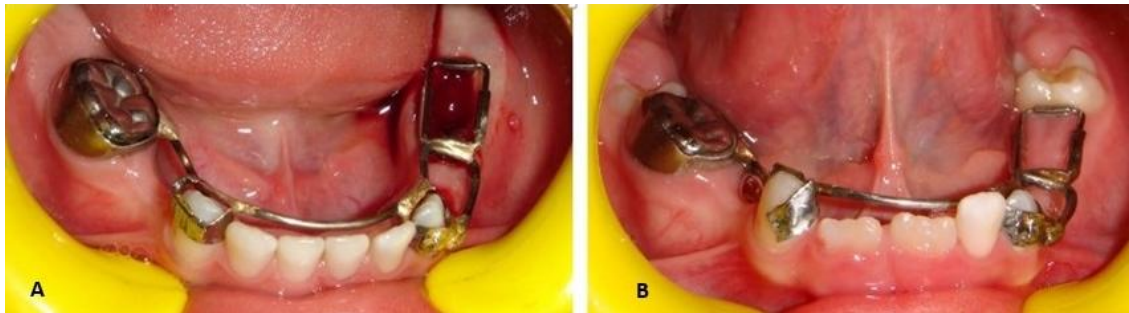
Case 4: A modified distal shoe appliance was designed and fabricated for a 4 years old boy before the extraction of the second primary molar. The appliance was cemented immediately after the extraction of the primary left second molar. After 1.5 years, the first permanent molars were erupted in their position by the guidance of vertical blade (Figure 9).



**Figure 7.** Second case; A: Use of a modified distal shoe appliance in a 4.5-year-old girl, B: Eruption of the first permanent molars in the correct position, C: Eruption was completed at 6 years of age



**Figure 8.** Third case; A: Modified distal shoe appliance in a 5 years old girl suffering from early loss of multiple primary molars on the right side, B: Eruption was completed at 6 years and 4 months old



**Figure 9.** Fourth case; A: Immediate insertion of a modified distal shoe appliance after extraction of lower second molar in a 4 years old patient, B: Permanent first molar erupted at 5 years and 9months old

## Discussion

Dental treatment of patients with early loss of multiple primary molars is a challenge for pedodontists. In the case of loss of second primary molar before the eruption of permanent first molars, it is necessary to place a space maintainer in order to guide the eruption of the permanent first molars into correct path. Distal shoe space maintainers are commonly and successfully used in such cases. However, in specific clinical situations i.e. loss of several primary molars, this appliance cannot be used. Removable appliances are also associated with some drawbacks such as the need for complete patient cooperation and the risk of fracture or losing the appliance [15]. In these cases, if left untreated, the first permanent molar would move mesially and space loss would occur which result in a need for active therapy. Active appliances also have some complications and patients and their parents should have full cooperation. Therefore, it is desirable to have an affordable method that requires a moderate level of patient cooperation that can guide the eruption of permanent first molars towards their correct position in the dental arch. For this purpose, the use of modified distal shoe appliance would be suggested as the treatment plan. Benefitting from the anchorage provided by the remaining teeth in the dental arch, a fixed, bilateral appliance with an intra-alveolar extension was fabricated, which was capable of guiding the eruption of the first permanent molar into its proper position. By placing this appliance, space loss due to mesial drifting of the permanent first molar could be

prevented. Moreover, this appliance would be more easily tolerated by children due to its fixed nature, simplicity, and optimal stability compared to removable appliances. However, this design has some shortcomings as well, including its difficult fabrication, relatively high cost, and non-functionality [12]. In uncooperative children, this appliance is preferred to removable alternatives. Modified distal shoe space maintainer is considered a short-term appliance that will be replaced with other appliances depending on the eruption of the first permanent molars and permanent incisors.

Placement of a wire such as a lingual arch on the lingual surface of anterior teeth may interfere with the eruption of permanent successors and would require the need for more frequent follow-ups with short intervals. However, studies have shown that in the case of early loss of primary molars, the eruption of the first permanent molar occurs sooner than expected [16,17]. Thus, the eruption of mandibular incisors prior to the complete eruption of permanent first molars would be less concerning. In our treated cases, bands were placed on abutment teeth even if they have been restored with SSCs. Placing band on the SSC of restored abutment allows easy retrieval of the appliance in the case of it is needed to get fixed while maintaining the integrity of appliance is required. In contrast to our case, Gujjar et al [12], Dhindsa and Pindat [13], and Bhat et al [14]. used uniform appliances that did not have the potential of chairside adjustability and the whole appliance was fabricated in a laboratory. The current appliance

was fabricated by soldering a part of the Gerber-type distal shoe to confer chair-side adjustability to the appliance. Therefore, the appliance could be adjusted easier and more precise. Movement of the distal blade in the tube enables and ensures the correct position of the intra-alveolar extension of the appliance. Following the complete eruption of the first permanent molar or observing any interference with the eruption of permanent incisors, the appliance must be replaced with other types of space maintainers depending on the clinical conditions of patients.

In conclusion, the Placement of modified distal shoe appliance preserves the integrity of dental arch and prevents space loss following the early loss of several primary molars in the cases that the use of conventional distal shoe appliance is not possible. However, regular patient follow-ups are critical for the success of this contemporary treatment plan.

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