Modified Distal Shoe Appliance–Fabrication and Clinical Performance

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ABSTRACT

When the primary second molar is prematurely lost, mesial movement and migration of the permanent first molar often occurs. This is one of the most difficult problems of the developing dentition confronted by pediatric dentists. Use of a space maintainer that will guide the permanent first molar into its normal position is indicated. In cases with bilateral premature loss of primary molars, the conventional design of distal shoe poses a variety of problems and, therefore, necessitates a customized design for the eruption guidance of permanent first molars. The purpose of this case report is to discuss an innovative design of a distal shoe appliance, which was used with good clinical results. (J Dent Child 2012;79(3):185-8)

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One of the most valuable tools that pediatric dentists can use when a primary second molar is lost prematurely is the distal shoe appliance (**DSA**), which helps guide the permanent first molar into place. The distal shoe space maintainer was first introduced by Gerber[1] and modified by Croll.[2,3] Its indications and contraindications were discussed in detail by Hicks,[4] who preferred fabrication of a cast gold appliance, although appliances with attachments soldered to stainless steel crowns or bands were clinically acceptable. Brill[5] described chairside fabrication of a distal shoe space maintainer to be delivered immediately after the extraction which showed a high success rate if the patient was cooperative.

There are several conditions that contraindicate the use of the DSA. If several teeth are missing, abutments to support a cemented appliance may be absent. Poor oral hygiene or lack of patient and parental cooperation greatly reduces the possibility of a successful clinical result. Certain medical conditions, such as blood dyscrasias, immunosuppression, congenital heart defects, rheumatic fever, diabetes, and generalized debilitation, may be a contraindication to its use. Cases in which DSA use is contraindicated, 2 possibilities for treatment exist:

1. Allow the tooth to erupt and regain space later.
2. Use a removable or fixed appliance that does not penetrate the tissue but places pressure on the ridge mesial to the unerupted permanent molar.[6]

Carroll and Jones reported 3 cases in which a removable or fixed pressure appliance was used to guide the permanent molar as it erupted.[7]

The purpose of this case report is to describe the clinical management of extensively carious primary mandibular molars with a modified DSA.

CASE REPORT

A 5-year-old boy reported to the Department of Pediatric Dentistry, S.D.M College of Dental Sciences, Dharwad, India, with a chief complaint of pain and recurrent swelling on the posterior area of the mandible bilaterally. His

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medical history was non-contributory. A clinical examination revealed a grossly decayed primary mandibular left second molar and a primary mandibular left first molar restored with an occlusal amalgam following a pulpotomy. Both primary mandibular right molars presented extensive caries with only root stumps remaining (Figure 1). The patient's oral hygiene was fair at first and the the appliance was only considered after an improvement was seen.

A periapical radiograph of the left mandibular posterior area showed a large periapical abscess in the primary second molar (Figure 2). A periapical radiograph of the right mandibular posterior area revealed root stumps of both primary molars (Figure 3).

A modified DSA was planned, consisting of a stainless steel crown retainer (3M ESPE, St. Paul, Minn., USA) on the primary mandibular left first molar and a band adapted on the primary mandibular right canine. A wire component consisted of a lingual-arch, which was extended bilaterally as a distal shoe using a 0.8-mm gauge orthodontic stainless steel wire. The lingual arch wire was placed as lingually as possible so as to not interfere with with the eruption of the permanent mandibular incisors. The length of the horizontal arm was measured on both sides on the preoperative radiographs. The vertical depth of the intragingival extension was calculated radiographically, approximately about 1.5 mm below the mesial marginal ridge, just sufficient to touch the mesial surface of the permanent mandibular first molars. A vertical cut was made on the working model, and the wire components were adapted on both sides, then soldered to the stainless steel crown and the band on the primary mandibular right canine.

After obtaining informed consent from his parents, extraction of the root stumps of the primary mandibular right first and second molars and the grossly decayed primary mandibular left second molar was performed. Before cementing the appliance, a radiograph was obtained to determine the proper relationship of the tissue extension with the unerupted first permanent molars (Figures 4 and 5). Final adjustments in length and contour were made prior to cementation. After cementing the appliance with type I glass ionomer luting cement (GC Fuji, Tokyo, Japan), appropriate instructions were given to the patient regarding appliance and oral hygiene maintenance. Figure 6 shows the intraoral view of the appliance 24 hours after insertion.

The patient was recalled every month for a checkup to evaluate the integrity of the appliance and supporting teeth and the eruption status of the permanent mandibular first molars and permanent mandibular incisors. The patient's parents were asked to assist him with toothbrushing because his oral hygiene had deteriorated. Two months later, the permanent mandibular first molars had erupted (Figure 7). Clinically,

Figure 1. Preoperative intraoral photograph.

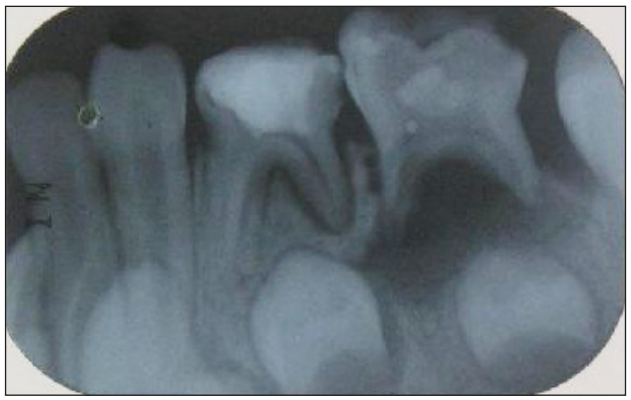

Figure 2. Preoperative radiograph of the primary mandibular left molar region.

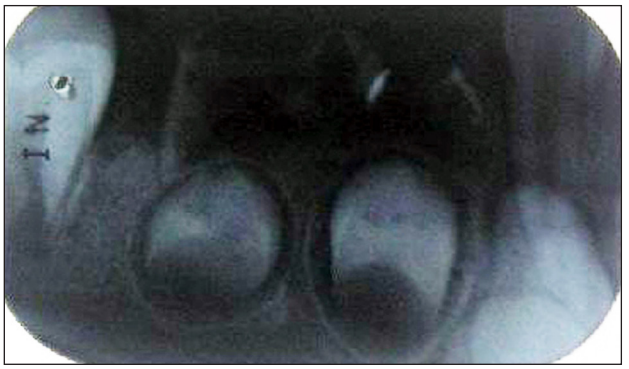

Figure 3. Preoperative radiograph of the primary mandibular right molar region.

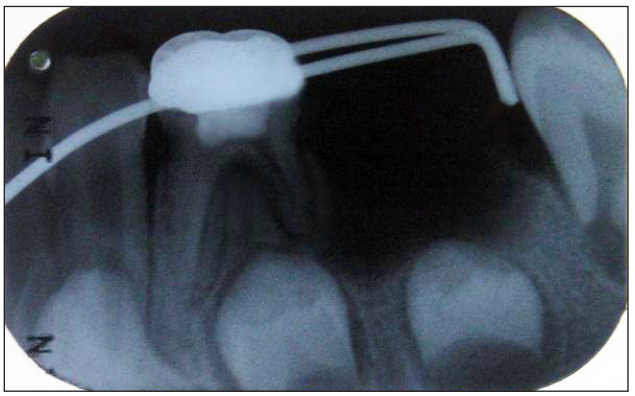

Figure 4. Radiograph of the primary mandibular left molar region showing the relationship of the distal shoe extension with the unerupted permanent first molar prior to cementation.

they showed white opacities and rounded cusps on the occlusal surfaces, probably due to enamel hypoplasia. The staining present on the occlusal surface may have been due to difficulty in maintaining the oral hygiene in the posterior region. Radiographically, the reason for the apparent changes in the periodontal space observed post-operatively on the mandibular primary first molar could be due to a change in the angulation of the radiograph or an improvement of the periapical condition (Figure 8).

The patient tolerated the appliance well, despite his difficulties with oral hygiene. After the permanent mandibular first molars erupt completely, the DSA will be replaced with a bilateral band and loop space maintainer. A short span on the left side and a long span on the right side will be created, with the erupted permanent mandibular first molars used as an abutment until the permanent mandibular incisors erupt after which a lingual arch space maintainer could be placed.

DISCUSSION

Management of cases with prematurely lost bilateral primary molars is a clinical challenge for pediatric dentists. The conventional design of the DSA cannot be used in clinical situations with multiple tooth loss.

The disadvantages with removable space maintainers, such as requiring cooperation by the patient and the possibility of being lost or broken, have led to a preference for fixed space maintainers. Foster reported that a well-designed fixed space maintainer could be more preferable than a removable appliance.[8]

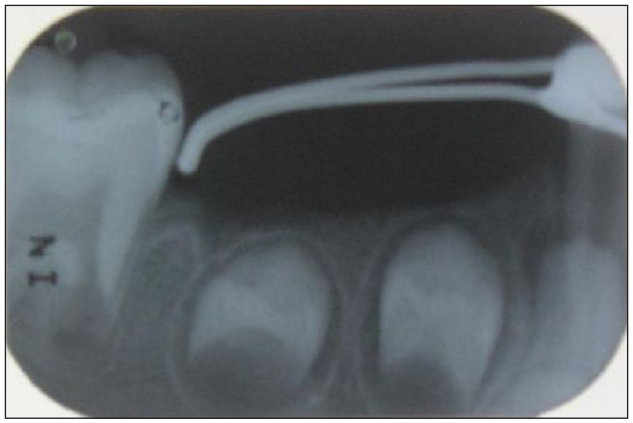

Figure 5. Radiograph of the primary mandibular right molar region showing the relationship of the distal shoe extension with the unerupted permanent first molar prior to cementation.

Figure 6. Intraoral photograph of the distal shoe appliance in place 24 hours after cementation.

Figure 7. Photograph showing the appliance during the 2-month follow-up with the permanent mandibular first molars erupted.

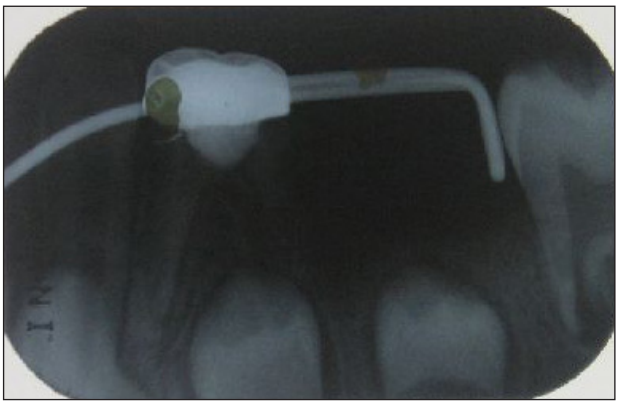

Figure 8. Radiograph of the primary mandibular left molar region during the 2-month follow-up.

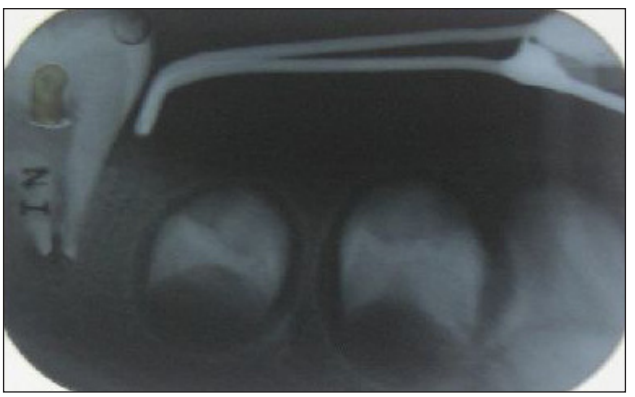

Figure 9. Radiograph of the primary mandibular right molar region during the 2-month follow-up.

In the present case, modification of the fixed DSA was considered to aid the guidance of the permanent mandibular first molars bilaterally. This modification offers the following advantages: simple design with minimal adjustment, increased stability and strength, ability to maintain the mesiodistal space bilaterally, favorable eruption guidance of the permanent mandibular first molars bilaterally, better appliance integrity, and better acceptance and tolerability by the patient. Disadvantages of this appliance include difficulty in its construction, high expense involved, and difficulty maintaining oral hygiene. It is a nonfunctional appliance, the use of which may be difficult in highly uncooperative patients.

The bilateral distal shoe design discussed in this case may be considered as a short-term appliance for guiding permanent mandibular first molars. The lingual arch portion of the design may cause interference with the eruption of permanent mandibular incisors. Hence, the duration of use of the appliance was subjected to close monitoring of eruption of permanent mandibular incisors clinically and radiographically. Once the permanent mandibular incisors erupt, it would be prudent to replace the appliance with a lower lingual holding arch space maintainer. Alternatively, the appliance may be modified by placing the lingual arch wire more lingually in such a way that it doesn't interfere with the eruption of the permanent mandibular incisors as well as tongue movement.

The time frame for which the appliance was used was short (approximately 2 months). Long-term clinical studies are dictated to determine the efficacy of this appliance.

The present report showed that this customized DSA was stable and showed acceptability by the patient.

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