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CASE REPORT

Optimal fit of chairside-fabricated distal shoe space maintainer

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Abstract
Background Premature loss of a primary second molar may lead to space loss in the dental arch. This space loss tends to be more severe in unfavourable malocclusions. The distal shoe space maintainer (DSSM) may be beneficial in controlling the path of eruption of an unerupted permanent first molar from the primary into the early mixed dentition.
Technique This article describes the technique for achieving optimal fit of a chairside-fabricated band and DSSM in a single visit by contouring the distal shoe blade, and by extending it to the mesial surface of the permanent first molar.
Follow-up care Upon the eruption of the permanent first molar DSSM may be modified to a reverse band-and-loop, or replaced by a lingual holding arch.

Keywords Distal shoe · Space maintainer · Space management · Malocclusion

Background

Premature loss of a primary second molar may lead to space loss in the dental arch (Ngan and Wei 1990; Brothwell 1997; Terlaje and Donly 2001; Tunison et al. 2008). This space loss tends to be more severe in cases with crowding, rotations, ectopic eruption, crossbite, excessive overjet and overbite, and unfavourable molar relationship (Brothwell 1997). Earlier age of tooth loss, particularly before the eruption of the permanent first molar, and loss of the primary second molar compared to that of the primary first molar also lead to more severe space loss (Hoffding and Kisling 1978; Kisling and Hoffding 1979; Northway et al. 1984).

The distal shoe space maintainer (DSSM) may be beneficial in controlling the path of eruption of an unerupted permanent first molar from primary into early mixed dentition. The indications and contra-indication for its use, laboratory and chairside fabrication, and its success and retention have been well described in the paediatric dentistry literature (Gegenheimer and Donly 1992; Brill 2002; Christiansen 2005). DSSM may be used in the event of premature loss of the primary second molar, ankylosis and submergence of the primary second molar, and ectopic eruption pattern of the primary second molar or the permanent first molar, which require space maintenance (Hicks 1973).

A distal shoe blade that is not contoured and adapted to the mesial surface of the permanent first molar may cause inadvertent damage to the follicle of the second premolar by directly impinging on the developing tooth. Such damage may present itself in the form of a hypoplastic tooth structure (Kirshenblatt and Kulkarni 2011). A straight distal shoe blade also does not enhance the mechanical retention of DSSM, as it provides no mechanical resistance to the occlusal pull during mastication. By contrast, a well-contoured distal shoe blade, offers optimal adaptation to the mesial convexity of the permanent first molar, provides additional mechanical retention and reduces the risk of impingement on the developing follicle of the permanent tooth. DSSM may be laboratory or chairside fabricated.

The ideal time for the placement of DSSM is immediately following the extraction of the tooth for which the

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space maintainer is indicated. Some of the advantages of immediate placement of DSSM are the presence of local analgesia, single-appointment visit, simultaneous post-operative recovery, reduced risk of space loss, better approximation for intra-alveolar placement of the distal shoe blade, and the ability to confirm and adjust fit with the use of a post-operative radiograph. The immediate placement of DSSM negates the potential for space loss which occurs immediately after tooth loss. Single-appointment, chairside-fabricated placement of crown-and-distal shoe space maintainer (CDSSM) has been described by Brill (2002). Compared with a CDSSM (Denovo Dental Inc., Baldwin Park, CA), a band-and-distal shoe space maintainer (BDSSM) offers enhanced ease of removal, ease of modification to a reverse band-and-loop space maintainer after the eruption of the permanent first molar, reduced gingival inflammation around the abutment tooth, and avoidance of placing an unnecessary preformed metal crown on the abutment tooth. Brill (2002) also suggested extending the distal shoe to the most distal aspect of the extraction socket, which does not correspond to the exact position of the mesial surface of the unerupted permanent first molar.

This article describes the technique for achieving optimal adaptation of chairside-fabricated BDSSM in a single visit by contouring the distal shoe blade, and by extending the DSSM to the distal wall of the extraction socket for adaptation to the mesial surface of the permanent first molar.

Technique

Indications and contra-indications for the placement of DSSM should be considered prior to the appointment. A pre-operative periapical or large bitewing radiograph taken parallel to the affected tooth is essential to confirm existing pathology, to assess the presence of the second premolar follicle, and to evaluate root health and length of the abutment tooth (Fig. 1). The abutment should be restored with an intra-coronal or a preformed metal crown restoration, if needed, prior to extracting the primary second molar. Haemostasis may be enhanced with the use of haemostatic agents; such as Gelfoam (Pfizer, New York, NY). An appropriate-sized band with the female attachment is fitted on the primary first molar. For abutment teeth that are unusually small, placement of a CDSSM may be necessary, especially if the anatomy of the primary first molar precludes good band adaptation. An appropriate width loop and distal shoe is then chosen, trimmed to the desired length, and smoothed with green stone, if necessary.

In order to approximate the mesial contour of the permanent first molar, a contouring, three-prong, or crown-

Fig. 1 Pre-operative radiograph of tooth #85 showing area of rarefaction in bifurcation area with extraction indicated

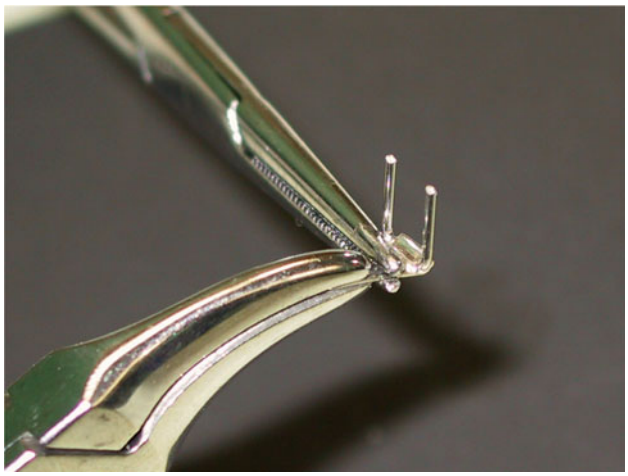

Fig. 2 Distal shoe blade is contoured using a contouring plier (#114, Denovo Dental Inc., Baldwin Park, CA)

crimping plier is used (Fig. 2). To prevent breakage of the solder joint, a haemostat may be used at the proximal end of the distal shoe blade (Fig. 2). Once the BDSSM is assembled, it should be tried in and a periapical radiograph taken to confirm fit prior to cementation (Figs. 3, 4, and 5). A crown-crimping plier may be used to increase the gingival convergence of the band, enhancing its retention prior to cementation. The BDSSM may be cemented after confirming the fit.

The vertical length of the intra-alveolar extension is critical for optimal fit. The distal shoe blade should at least replace the distal surface of the distal root of the primary second molar, as this is the surface that guides the permanent first molar eruption. This allows for placement of the distal shoe against the distal aspect of the extraction socket. However, to contact the mesial surface of the permanent first molar, the distal shoe placement should be

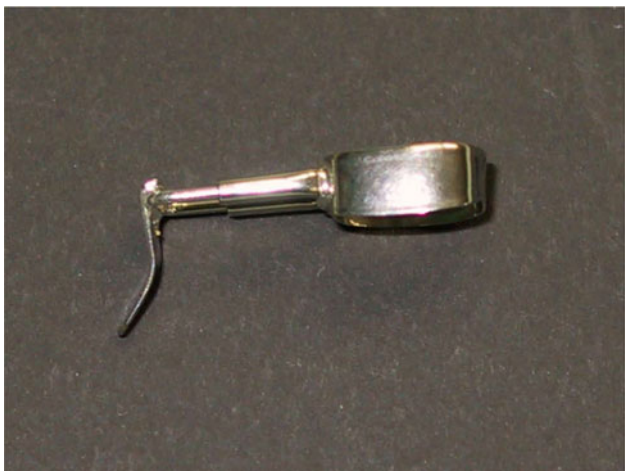

Fig. 3 Band and distal shoe space maintainer (BDSSM) is assembled prior to crimping the receiving tube

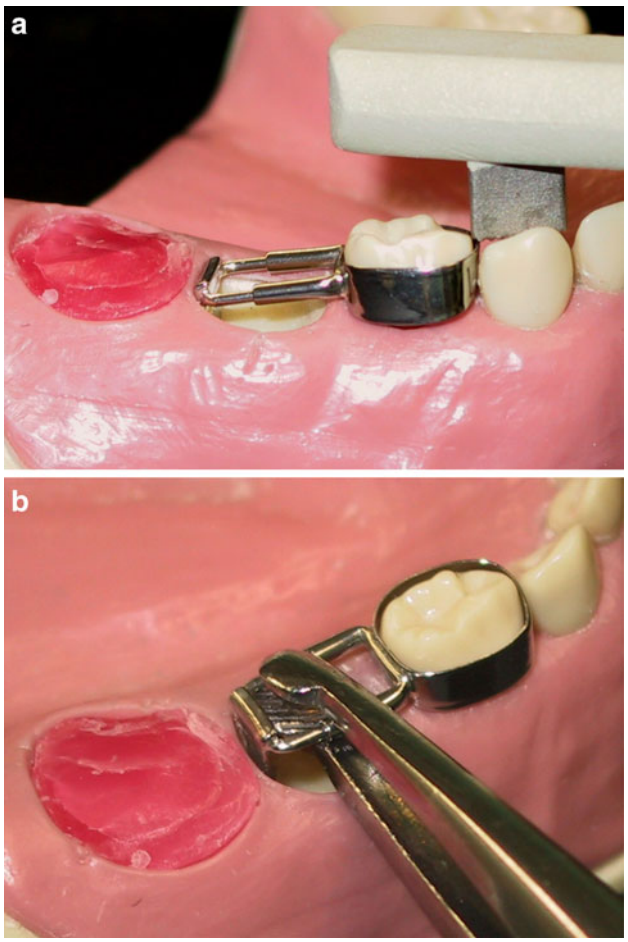

Fig. 4 Using a model for demonstration: **a** band and distal shoe space maintainer (BDSSM) is positioned in place with apical tilt, **b** the distal shoe blade of BDSSM is moved coronally for optimal fit to the mesial surface of the permanent first molar tooth

beyond the distal wall of the socket. Placement of the longer distal shoe would become more technically sensitive. First, the distal shoe is placed against the distal surface

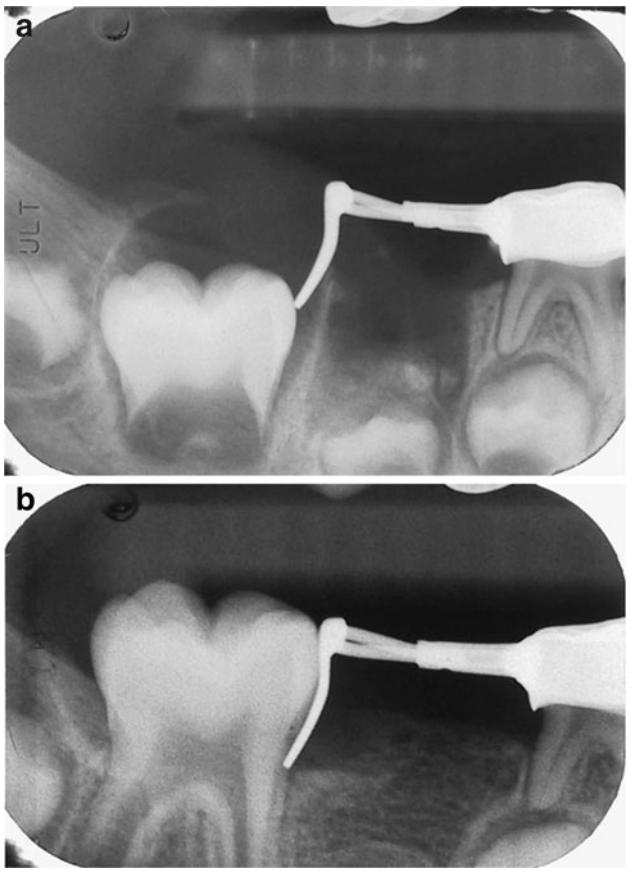

Fig. 5 Radiographs demonstrating placement of band and distal shoe space maintainer (BDSSM): **a** taken immediately after BDSSM is cemented into place with optimal fit to the mesial marginal ridge surface of the permanent first molar tooth, and **b** 2 years post-operative with the permanent first molar erupted into an ideal position

of the alveolar socket with an apical tilt toward the distal (Fig. 4a), then the band is seated and adapted, and finally the loop is moved slightly coronal with the use of a Howe plier (Fig. 4b). This last step may cause a slight displacement of the thin distal wall of the alveolar socket, and thus allows for closer approximation of the distal shoe blade to the mesial contour of the permanent first molar (Fig. 5a). The tight fit may also play a role in enhancing the mechanical retention of the distal shoe. As the permanent first molar erupts, its mesial surface matches the contour of the distal shoe blade (Fig. 5b). The mesial-distal width of the appliance guides the eruption of the permanent first molar.

With practice, the BDSSM may be cemented with optimal fit prior to taking the post-operative periapical radiograph. If the treatment is being performed under general anaesthesia, by arranging the order of procedures, the post-operative periapical film may be taken before completing other procedures to allow time for the film to be developed. Digital radiography is beneficial in such instances.

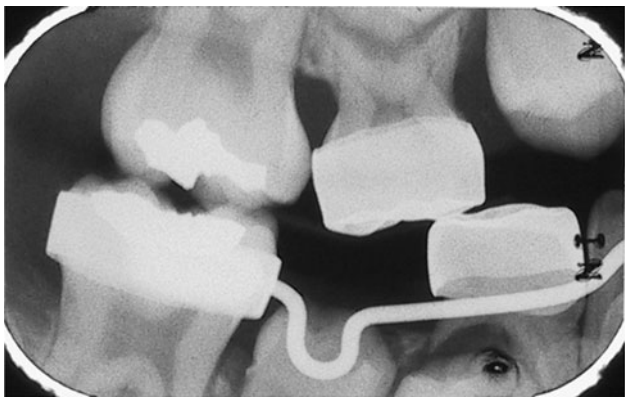

Fig. 6 Follow-up radiograph after 6 years showing eruption of the second premolar into a good position with a lower holding arch in place

Post-operative and follow-up instructions should include oral hygiene instructions and dietary restrictions to avoid hard and sticky food to minimise the risk of BDSSM dislodgment. This is particularly important in the first few weeks before the osseous repair of the extraction socket is completed.

Follow-up care

The contoured curvature introduced in the distal shoe will enhance the retention of BDSSM, but makes the removal after eruption of the permanent first molar more challenging. At that time, when BDSSM is not intended to be modified to a reverse band-and-loop, the removal of BDSSM may be simplified using a wire cutter or a high-speed handpiece to cut away the distal shoe from the loop. Thereafter the distal shoe and the band may be removed separately. Topical analgesic spray enhances patient comfort. Following the removal of BDSSM, a lingual holding arch (LHA) may be necessary for space maintenance until the eruption of the second premolar tooth (Fig. 6).

If BDSSM comes loose prior to the full eruption of the permanent first molar, it may be removed under topical or local analgesia, and recemented once again as a BDSSM, or it may be modified into a reverse band-and-loop by removing the distal shoe blade. In instances when BDSSM needs to be maintained for a longer period of time, the length of the blade must be reduced to minimise its effect on the periodontal tissue mesial to the erupting permanent first molar. This is performed by removing the appliance, shortening the intra-gingival component and recementing the band.

Conclusions

The DSSM is a useful appliance in paediatric dentistry as space loss in the area of the primary second molar may be very significant during the eruption of the permanent first molar. This article describes the steps in achieving optimal fit of immediate chairside-fabricated BDSSM. Introduction of proper anatomical contour in the distal shoe blade and its adaptation to the mesial surface of the permanent first molar are critical. Ongoing management is needed as the patient makes the transition through the mixed to the permanent dentition.

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