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A new design for space maintainers replacing prematurely lost first primary molars

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Abstract

Studies of the developing anterior occlusion in the mixed dentition indicate a physiologic distal and labial repositioning of the primary canines concomitant to eruption of the maxillary and mandibular permanent incisors. In order not to impede these canine movements, a modification of the loops of bandloop space maintainers is recommended. In place of the usual concavity which encircles the distal surface of the canine crown, a distolabial slope is incorporated into the anterior portion of the loop. This revised design will allow the canine to migrate labially and distally while simultaneously preventing loss of arch length necessary for the unerupted first premolar. In addition, arch space required for eruption and alignment of permanent labial incisors can be preserved.

Space maintainers frequently are recommended to preserve arch space resulting from premature loss of first primary molars. Changes occurring in the developing anterior occlusion during mixed dentition require that the space previously occupied by a prematurely lost first primary molar be maintained. This article will describe a modification of the design of first primary molar space maintainers based on growth changes occurring in the canine areas of the mixed dentition.

Indications for Space Maintenance

Space maintainers replacing prematurely lost first primary molars usually are regarded as being unnecessary during the primary dentition as arch length rarely is lost.[1-3] On the other hand, replacing prematurely lost first primary molars with space maintainers during and after eruption of the permanent lateral incisors and first permanent molars is recommended.[1,4-7]

Mandibular Anterior Occlusion Development

Primary dentitions exhibiting anterior interdental and primate spacing (or the lack of such spacing) frequently undergo characteristic physiologic growth changes in their progression through the mixed dentition (Figures 1 and 2). The mandibular first permanent molars frequently erupt before the mandibular incisiors.[8] The mandibular permanent central incisors erupt next, lingual to the exfoliating or exfoliated primary central incisors, often exhibiting a mesial rotation (Figure 1a).[8,9] Pressures from the tongue in conjunction with reciprocal pressure from the perioral muscles align the permanent central incisors into the dental arch (Figure 1b).[9]

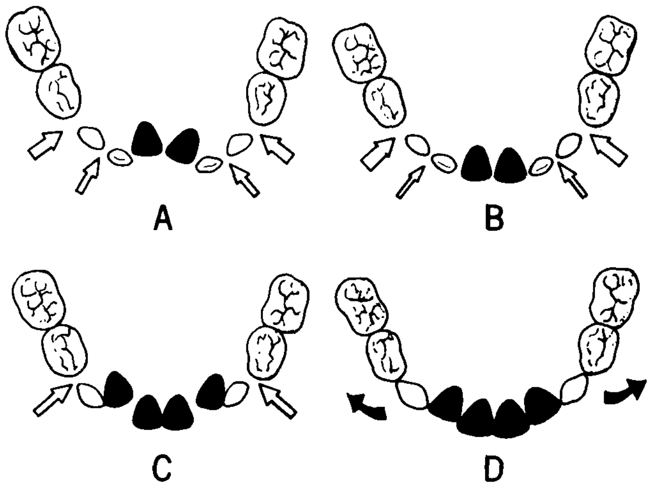

Figure 1. Model of the developing mandibular anterior occlusion showing repositioning of primary canines.
a. Eruption of the permanent central incisors (shaded) lingual to the position previously occupied by the primary central incisors. The width of the arrows indicates relative amount of interdental spacing.
b. The permanent central incisors have moved into the dental arch displacing the primary lateral incisors distally and reducing the interdental spacing.
c. The erupting permanent lateral incisors (shaded) ready to occupy arch space previously held by the exfoliated primary lateral incisors. Notice reduction of the primate spacing.
d. The primary canines repositioned labially and distally in the dental arch as a result of eruption of the permanent lateral incisors. Mandibular primate spacing has closed and intercanine width has increased.

Permanent incisors, because of their larger mesiodistal width, occupy arch space previously held by their smaller primary antecedents (as well as their adjacent mesial and distal interdental spaces). During or following exfoliation of the primary lateral incisors, the permanent lateral successors also erupt into lingually and mesially rotated positions (Figure 1c). Persisting midline and other anterior interdental spaces tend to close. The permanent lateral incisors, as they strive to position themselves within the dental arch, exert distally and labially directed forces on the primary canines (Figure 1d).[9] The mandibular primate spaces, located distally to the primary canines, become shortened or even closed anteroposteriorly.[9,10]

Mandibular primate spaces also may close posteroanteriorly as a result of forces arsing in the posterior portion of the arch.[10] Anteriorly directed forces originating from the erupting first permanent molars may move the first and second primary molars forward, closing the primate spaces posteroanteriorly. It may be reasonable to anticipate that mandibular primate spaces close as a result of both of these anteriorly and posteriorly directed eruptive and muscular forces. A complete alignment of the lateral incisors is not achieved regularly as sufficient arch length usually is not present to accommodate these teeth.[7,9]

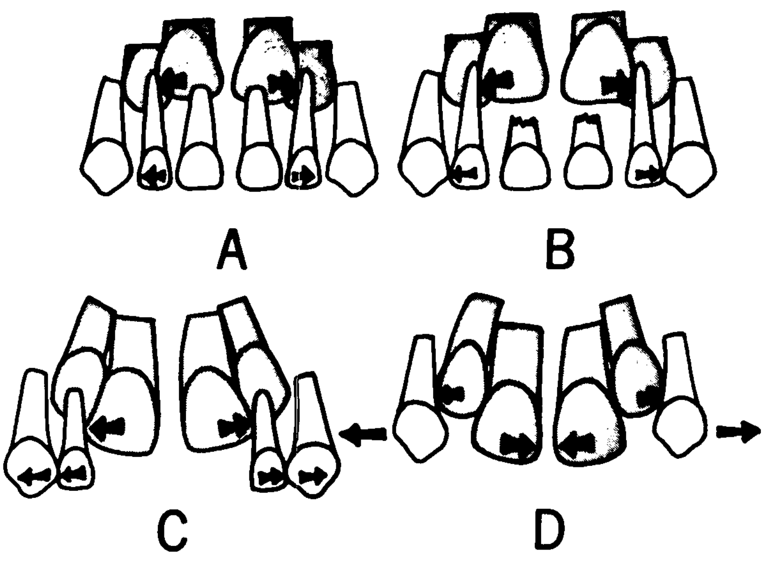

Figure 2. Model of the developing maxillary anterior occlusion showing repositioning of the primary canines.
a. The crowns of the erupting permanent central incisors contact the roots of the primary lateral incisors, moving these teeth distally.
b. Further eruption of the central incisors in which the primary lateral incisors move into the maxillary primate spaces.
c. Continued eruption of the permanent central incisors forcing the canines distally and labially, increasing intercanine width.
d. Increase in bicanine width would be jeopardized if the primary lateral incisors were lost prematurely (after Van der Linden).

Relocation of the mandibular primary canines to a more distolabial position in the dental arch occurs predominantly during eruption of the permanent lateral incisors.[9] This movement of the primary canines has been documented as an increase in the intercanine arch width of approximately 2-3 mm in the dentitions with interdental spacing, and 2.5-5.0 mm in dentitions without spacing (Figure 1d).[6-18] The mandibular canine orientation changes to a more distolabial location because of the direction of the forces exerted by the permanent lateral incisors and curved dental arch. Because minimal apositional bone growth occurs on the alveolar process, little movement of teeth would be expected.[9]

Maxillary Occlusion Development

Accommodation of the maxillary permanent incisors into the space previously occupied by the primary incisors and their adjacent interdental spaces, occurs in a different manner than that of the lower arch. It has been suggested that the distal crown surfaces of the erupting maxillary permanent central incisors contact the mesial surfaces of the primary lateral incisor roots, moving these teeth distally (Figure 2a).[18] Such distal repositioning of the primary lateral incisors would close the maxillary primate spaces mesial to the primary canines.

Further eruption of the permanent central incisors would cause their distal crown surfaces to force both the primary lateral incisors and canines into more distal and labial positions within the dental arch. In this manner, maxillary intercanine arch width is increased (Figures 2b,c).[19] As no space usually exists distal to the primary canines, some bone growth probably acts in conjunction with tooth movement and/or tooth inclination in achieving canine repositioning. A premature loss of a primary lateral incisor would tend to interfere with an increase in intercanine width.[17]

A mean increase in intercanine width of 4 mm occurs in the maxillary arch.[6-18] This increase is greater than the mean increase recorded for the mandibular arch.[18] As development of the mandibular occlusion usually precedes that of the maxilla, the maxillary primary canines move distolabially in harmony with mandibular canines. This physiologic movement of the maxillary canines would prevent traumatic contacts developing with the mandibular canines, causing their possible premature loss.[9] Additional arch space also is gained by a greater labial inclination of the permanent incisors compared to that of their primary antecedents.[9,10]

Interpretation

During the formation of the anterior occlusion, developmental data indicates a physiologic movement of the maxillary and mandibular canines in a distolabial direction. Canine movements in the lower arch occur primarily during eruption of the permanent lateral incisors, while in the upper arch during eruption of the permanent central incisors. Immobilization of a primary canine by a space-maintaining appliance could, therefore, prevent the documented physiologic tipping of this tooth. Loss of this canine movement could cause the mandibular permanent lateral incisor to be blocked lingually or to be forced to erupt ectopically against the primary canine roots causing its premature loss.[9] Immobilization of a maxillary canine could lead to premature resorption and loss of the primary lateral incisor. In addition, loss of the primary lateral incisor would tend to remove its influence on the canines, contributing to the increase of intercanine width.[9]

Loop Design of the Band-Loop Space Maintainer

The loop design of a band-loop space maintainer, used in replacing a prematurely lost first primary molar, should allow the previously identified physiologic movements of the primary canine. If the anterior portion of the loop contains a concavity which partially encloses the distal surface of the canine crown, present knowledge would indicate that the space maintainer would inhibit distolabial migration of the primary canine during eruption of the permanent central and lateral incisors. Consequently, a band-loop space maintainer inserted following premature loss of a first primary molar should be designed to allow canine migration without loss of arch length.

Such a design modification would consist of a mild distal slope on the anterior portion of the loop (Figure 3a). While a slope on the anterior portion of the loop would permit a canine to move in a distolabial direction, space still would be maintained in the dental arch equal to the mesiodistal dimension of the prematurely lost molar. A further advantage of such a change in loop design would be the ability of the permanent lateral incisors to move from a slight lingual position in the arch to one approaching normal alignment.

Related Applications

Similar modifications in design also can be incorporated into other types of space maintaining appliances. The traditional cast-crown T-bar space maintainer, used to replace prematurely lost first primary molars, would have the labiolingual portion of the T-bar sloping in a distolabial direction to allow canine movement (Figure 3b). Lingual holding arches, placed to maintain arch length during bilateral loss of primary molars, would contain distolabial sloping wires at the distal surfaces of the primary canines (Figure 3c). Similarly, removable acrylic space maintainers replacing bilaterally lost primary molars would have the acrylic base posterior to the primary canines trimmed to facilitate distal and lateral movements of the primary canines (Figure 3d).

Intra-alveolar space maintainers, inserted following premature loss of second primary molars to prevent mesial migration of unerupted first permanent molars, should not utilize both the primary canine and first molar as abutment teeth. Such a practice would inhibit the natural movement of the primary canine.

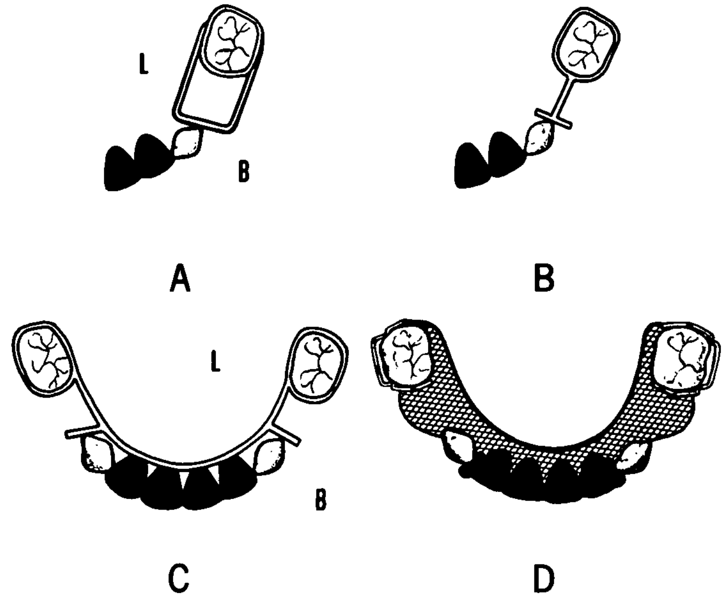

Figure 3. Modification of space maintainers which facilitates normal occlusal development in the canine region.
a. A band and loop space maintainer replacing a prematurely lost first primary molar. The anterior portion of the loop slopes in a buccal (B) and distal direction to allow physiologic movement of the primary canine. Sufficient space in the arch is maintained to accommodate the unerupted first premolar.
b. A cast T-bar space maintainer, replacing a prematurely lost first primary molar. The bar of the T-bar space maintainer slopes in a distobuccal direction to allow canine movement.
c. A lingual arch, bilateral space maintainer replacing prematurely lost first and second primary molars. Finger springs positioned distal to the primary canines are sloped in a distobuccal direction to facilitate canine repositioning.
d. A removable, bilateral space maintainer replacing prematurely lost first and second primary molars. Note the distobuccal slope created in the acrylic base material.

The practice of clasping primary canines to assist in the retention of removable space maintainers and orthodontic appliances would appear to be contraindicated during the period of eruption of permanent lateral incisors. However, clasps placed about primary canines before or after eruption of incisors would be appropriate.

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Quotable Quote

In a now famous article published in the *Harvard Educational Review* in 1969, Arthur R. Jensen of the University of California at Berkeley questioned how much scores on IQ tests could be raised by changing the environment in which the student is raised and educated. An answer now has been provided by a group of French educational psychologists. The results of their work, which appear in the journal *Cognition,* show that IQ scores can be raised at least 14 points by changing the social situation of the child at an early age. They conclude that a working class child raised in an upper middle class household will have an IQ and a school record very similar to those of the biological children of upper middle class parents.

The conclusion of the French workers contradicts the one by Jensen. In his *Harvard Educational Review* article, he argued that intelligence is determined primarily by hereditary factors. The environment exercises no more than a "threshold" effect: if the child has been deprived in infancy, placing him in a richer environment can raise his IQ to the genetically determined potential, but enriching the environment further will not yield a corresponding gain in IQ. According to Jensen, "children reared in rather average circumstances do not show an appreciable IQ gain as a result of being placed in a more culturally enriched environment . . . I have found no report of a group of children being given permanently superior IQs by means of environmental manipulations. In brief, it is doubtful that psychologists have found consistent evidence for any social environment influences short of extreme environmental isolation which have a marked systematic effect on intelligence."

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