



ORIGINAL ARTICLE

# Long-term space changes after premature loss of a primary maxillary first molar



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## KEYWORDS

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**Abstract** *Background/purpose:* The consequence of premature loss of primary teeth resulting in the need for space maintainers has been controversial for many years. There is no longitudinal long-term report in literature regarding the premature loss of a primary maxillary first molar. The aim of this study was to continue observing the long-term space changes of 19 cases following premature loss of a primary maxillary first molar during the transition from primary to permanent dentition.

*Materials and methods:* Ten of the 19 original participants were excluded because of extensive decay or loss to follow-up. Nine children (mean age at time of tooth extraction,  $6.0 \pm 0.42$  years) with unilateral premature loss of a primary maxillary first molar were examined. Maxillary dental study casts were obtained 2 days or 3 days after tooth removal and, on average, 81 months later. The contralateral intact primary molars in each participant served as controls. The arch width, arch length, intercanine width, intercanine length, and arch perimeter of each study cast from the initial and follow-up examinations were measured and compared using paired *t*-tests.

*Results:* Eight of nine cases (88.9%) did not show crowded permanent successors or canine block-out at the extraction site. Interestingly, the permanent dentition was more crowded at the control site (2/9) than at the extraction site (1/9). The arch width, arch length, intercanine width, and intercanine length significantly increased at 81 months ( $P < 0.05$ ), whereas the arch perimeter increases approached significance ( $P = 0.071$ ).

*Conclusion:* The anterior and posterior arch dimensions significantly increased 81 months after premature loss of a primary maxillary first molar, which suggested that space maintainers were not needed in these cases.

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## Introduction

Clinical studies of space changes that result from the premature loss of primary molars have a wide range of findings, including the direction of space change, the amount of space loss, and the need for a space maintainer.<sup>1–11</sup> These inconsistencies may have resulted because many early investigations had cross-sectional designs, small sample sizes, and somewhat crude methodologies.<sup>10</sup> Tunison et al<sup>12</sup> systematically reviewed all of the studies on space changes following the premature loss of primary first molars that had been published prior to July 2007 and found that the methods of only three of 79 were of sufficient high quality to warrant consideration for the review. Recent studies regarding space change after premature loss of a primary molar improved their methodologies by conducting longitudinal studies, using contralateral primary molars as controls, and increasing the sample sizes.<sup>13–18</sup> These studies concluded that the arch with the premature loss of deciduous molars did not exhibit any significant dimensional changes but the loss of second primary molars affected dental arch more than first primary molars did.<sup>18</sup>

The high quality of the methods of our serial studies of space changes following unilateral extraction of a primary first molar in either maxillary or mandibular arches during certain periods of arch development was recognized as a high methodological quality in Tunison et al's<sup>12</sup> review.<sup>12–15</sup> In 1998, we conducted a study with a strict sampling regimen and collected longitudinal data on the space changes after premature loss of a primary mandibular first molar. We found that the early space change in the mandibular dental arch consisted primarily of distal movement of ~1–1.5 mm of the primary canine toward the extraction space within 8 months.<sup>13</sup> In 2007, in a related study of the effects of the premature loss of a primary maxillary first molar, we found a similar distal drift of the primary canine, which was ~1 mm of space loss within 6 months of the extraction and which was likely not of sufficient clinical significance to warrant the use of a space maintainer.<sup>14</sup> In 2011, in a study that extended the follow-up of the 2007 study to 12 months, the anterior segment (intercanine width and length) was increased. The mesial movement of permanent molars or the tilting of the primary molars did not occur, which suggested that space maintainers are not needed in cases involving the premature loss of a primary first molar.<sup>15</sup>

In order to better understand the ongoing space changes after 12 months and during the transition from primary dentition to permanent dentition, the present study extended our previous investigations of the 6- and 12-month space changes after premature loss of a primary maxillary first molar. The purpose of this study was to use established longitudinal data to investigate ongoing (81 months) dental-arch space problems that resulted from premature loss of a primary maxillary first molar.

## Materials and methods

Nine children (seven boys and two girls) with unilateral premature loss of a primary maxillary first molar were selected for this study from the Children's Dental Clinic of

Kaohsiung Chang Gung Memorial Hospital. Ten of the 19 original participants were excluded because of extensive decay or loss to follow-up. All of the participants met the following inclusion criteria specified by the protocol described in our previous study,<sup>14,15</sup> as follows: (1) no major craniofacial disease was apparent; (2) the permanent first molars were about to erupt or had just erupted; (3) the patient was cooperative in finishing dental treatment before impressions were obtained; (4) the maxillary dentition featured the unilateral premature loss of a primary first molar due to extensive caries but had intact contralateral primary molars; (5) premature loss of the primary molar was defined as the absence of a permanent tooth for at least 2 years after extraction of the primary molar; however, the permanent tooth eventually would erupt into the space; (6) parents or guardians did not want their child to receive dental treatment involving the use of a space maintainer; and (7) all parents of the children included in the study signed a consent form. Ethical approval for the study was granted by the Institutional Review Board of Chang Gung Memorial Hospital (Institutional Review Board number 100-2162D).

Maxillary dental study casts of the participants were obtained 2 days or 3 days after the tooth was removed and at a follow-up appointment that occurred, on average, 81 months later. None of the study participants were treated with any type of space maintainer during the entire follow-up period. We obtained longitudinal study casts in order to compare them with the initial study casts. The five reference lines used as test parameters were measured directly from the reference points on the dental casts, and two experienced researchers (Y.-T. L. and W.-H. L.) determined the lines using an electronic digital caliper, which was accurate within 0.01 mm.

## Cast measurements

The researchers measured the following five reference lines of dental-arch development: arch width, arch length, intercanine width, intercanine length, and arch perimeter. We defined these parameters as follows:

- (1) the arch width is the distance between the central fossae on the occlusal surfaces of the two primary second molars (primary dentition) or two second premolars (permanent dentition); [Figures 1A and 2A](#);
- (2) the arch length is the perpendicular distance from the contact point of the central incisors to the arch width ([Figures 1A and 2A](#));
- (3) the intercanine width is the distance between the cusp tips of the two primary canines or two permanent canines ([Figures 1B and 2B](#));
- (4) the intercanine length is the perpendicular distance from the contact point of the central incisors to the intercanine width ([Figures 1B and 2B](#));
- (5) the arch perimeter, which is measured with the aid of brass wire, is the arc from the mesial midpoint of the permanent first molar (or the distal midpoint of the primary second molar) through the cusp tip of the canine and the incisal edges of the incisors to the opposite mesial midpoint of the permanent first

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