Mandibular Leeway Space of Taiwanese Children

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Leeway space, the most crucial space for the alignment of permanent teeth, is the difference between the sum of the mesiodistal crown widths of the primary canines and molars and that of their successors, the permanent canines and premolars. Primary molars have greater mesiodistal crown widths than the permanent premolars that replace them, especially the primary second molar. Leeway space has been preserved and utilized to resolve crowding, particularly by allowing the first molars to drift mesially to establish a Class I molar relationship in the late mixed dentition.

leeway space | mesiodistal crown width | permanent teeth | primary teeth | mixed dentition

1. Introduction

Leeway space, the most crucial space for the alignment of permanent teeth, is the difference between the sum of the mesiodistal crown widths of the primary canines and molars and that of their successors, the permanent canines and premolars [1]. Primary molars have greater mesiodistal crown widths than the permanent premolars that replace them, especially the primary second molar [2]. Leeway space has been preserved and utilized to resolve crowding [3], particularly by allowing the first molars to drift mesially to establish a Class I molar relationship in the late mixed dentition [4][5].

Leeway space has been reported to be affected by many factors, including ethnicity, [6] the crown size of primary [7] and permanent teeth [8], sex [9], and environmental factors [8]. The average leeway space was reported to be 0.9 and 1.8 mm per quadrant for the maxilla and mandible, respectively, in the United States [10]. Leeway space was reported to be 2.03 mm in the lower arch in Brazil [2]. Permanent teeth were demonstrated to have a secular trend of growing, leading to a significant reduction in leeway space [8]. Girls have more leeway space than boys have [9]. Environmental factors that reduce tooth crown dimensions may affect leeway space [11].

Leeway space is more crucial in the mandibular arch than in the maxillary arch; the therapeutic choices for the mandibular arch are limited because of the low potential for arch expansion and the difficulty of molar distalization [3][8] By contrast, spatial problems in the maxillary arch can be resolved through arch expansion, buccal tipping of the anterior segments, and molar distalization. As a result, the leeway space in the maxilla was negative in several cases [9]. Therefore, several studies have investigated leeway space in the mandibular arch [3][8] and utilizing leeway space in the mandible is one of the few means of resolving anterior arch crowding [4].

2. Current Insights

In the late mixed dentition, a loss of leeway space can cause dental crowding and malocclusion, and orthodontic treatment may be required. Therefore, preserving leeway space is crucial during the transition from the primary to permanent dentition. To our knowledge, this might be the first study related to leeway space in Asia. We determined the average leeway space to be 1.29 ± 1.48 mm on either side of the lower arch. No gender differences in leeway space were observed. Children aged 5–6 years had significantly greater leeway space than did those aged 7–8 years. Leeway space was significantly related to the crown width of primary and permanent teeth, except for the primary first molars of girls.

A lingual holding arch was used to preserve leeway space in the mandibular arch [12]. In the maxillary arch, the transpalatal arch and Nance appliance were used to preserve leeway space [13]. An unfavorable eruption sequence reduces the available space, and a lingual arch is recommended to preserve leeway space [14]. Because of the many functions of leeway space, if leeway space is prematurely lost, it must be regained. Crowding in the maxillary arch can be resolved through several methods, including arch expansion, buccal tipping of the anterior segments and molar distalization [9][15]. However, for the mandibular arch, the therapeutic choices are limited [3] and molar distalization is difficult. In one study, maxillary teeth were approximately equal to their primary counterparts [16]. Therefore, leeway space is more critical for the lower jaw than for the maxilla. This is why the presented study demonstrates the importance of leeway space, especially in the mandibular arch, during the transition from the primary to permanent dentition.

Earlier studies have reported that the measurement of average leeway space in mandible was between 1.8 mm and 3.6 mm [1][2][8][9][10]. Compared with the previous studies above, this study observed less leeway space in the mandible. Several factors may have influenced this result. First, most previous studies have been conducted outside of Asia, in regions such as the United States [8][10], South America [2][9] and others [1]. It looks as though ethnicity affects leeway space. Second, leeway space is determined by the crown width of the primary canines and first and second molars and the permanent canines and premolars. According to this study, leeway space was closely related to the crown size of permanent teeth. The sum of the crown widths of the permanent canines and premolars in this study was greater than those reported in previous studies in the United States, Mexico and the United Kingdom [9][17][18][19]. Larger crown diameters of permanent teeth might result in less leeway space. Furthermore, positive secular trends in the crown widths of permanent teeth have been observed [8][20]. This phenomenon could reduce leeway space.

In some studies, leeway space has been greater in girls than boys [9][21]. However, some researchers have found no gender differences in leeway space [8]. In this study, no significant differences between sexes were observed. The reason for the larger leeway space of girls in previous studies may have been the narrower crowns of the girls' permanent teeth, especially the canines, than those of the boys [9][18]. Narrower permanent crowns may be associated with greater leeway space. However, in the present study, when the crown widths of the boys' and girls' permanent and primary teeth were compared, there were no significant differences between sexes. Therefore, this might be the reason that the reason leeway space did not differ by gender in Taiwanese children.

In the present study, the leeway space of children aged 5–6 years was significantly greater than that of children aged 7–8 years, and the total crown size of their permanent teeth was significantly smaller. This may explain why children aged 5–6 years had significantly more space than those aged 7–8 years. The timing of tooth eruption from the jawbone is correlated with crown size, and smaller teeth germinate earlier than larger teeth. The smaller total crown size of the permanent teeth of children aged 5–6 years resulted in significantly more leeway space than in the group aged 7–8 years.

With larger primary crowns or smaller permanent crowns, leeway space is greater. In this study, leeway space had a positive correlation with the crown sizes of primary teeth and a negative correlation with the crown sizes of permanent teeth. In boys and all participants (not divided by sex), leeway space was correlated with primary and permanent tooth widths. However, in girls, leeway space had a higher correlation with permanent tooth width than primary tooth width. This indicates that, for girls, the size of permanent teeth affected leeway space more than that of primary teeth because the gender difference in permanent tooth size is greater than the primary tooth size.

3. Conclusions

The following conclusions were drawn:

- The average leeway space was 1.29 ± 1.48 mm on each side of the lower arch.
- The leeway space of children aged 5–6 years was significantly greater than that of children aged 7–8 years.
- No gender differences in mandibular leeway space were found.
- Permanent teeth had a greater impact on leeway space for girls than for boys.

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