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Research Article

Impact of extracted primary teeth on occlusion and its relation to weight status among a group of children

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Abstract

Introduction: Premature loss of primary molars can disrupt dental arch integrity, alter occlusal relationships, and predispose to malocclusion. Concurrently, undernutrition may influence craniofacial growth, compounding occlusal disturbances.

Aims: The study's objectives were to assess the effects of early primary molar extraction on the formation of occlusal relationships and investigate its relationship to children's weight-for-age status.

Materials and methods: A cross-sectional study was conducted on 200 children between the ages of 7 and 8. Each child was examined to ascertain the presence of any premature loss of primary molars in the upper or lower jaw, evaluated on a unilateral basis. The occlusal relationship of molar permanent teeth was evaluated bilaterally, and the weight-for-age Z-score (WAZ) was assessed. A comprehensive statistical analysis was conducted, encompassing percentage distributions, one-way analysis of variance (ANOVA), and the Pearson chi-square test, with a significance level of 5%. This analysis was undertaken to ascertain the associations between premature tooth loss, occlusion, and malnutrition.

Results: The most prevalent tooth that had been prematurely lost was the lower first primary molar (38%). A difference in Angle's molar relationship between the extracted and the control sides was observed, especially among those with premature loss of the second primary molar. The mean WAZ value was significantly lower among children with Class III Angle's molar relationship on the extracted side ($F=16.158$, $p<0.01$). However, it was significantly lower among children with Class II Angle's molar relationship on the control side ($F=33.665$, $p<0.01$).

Conclusions: Premature loss of the primary second molar in the upper arch changed the Angle's molar classification towards Class II, while in the lower jaw, the Angle's molar classification changed to Class III. Undernutrition further increases malocclusion risk, emphasizing the need for preventive care and integrated management that addresses both oral and systemic health.

Keywords

Angle's classification, child, malocclusion, nutritional status, oral health, premature loss

Introduction

One of the most important goals in pediatric dentistry is to keep baby teeth healthy before they erupt into permanent teeth.[1] Primary dentition can help to preserve arch length and facilitate the formation of proper and functional permanent occlusion. When exfoliation of deciduous teeth, a normal physiological phenomenon, is disrupted, serial changes occur in the dental arches.[2,3]

Premature loss of primary dentition is predominantly attributable to atypical root resorption, dental caries, or trauma and may result in space loss, midline discrepancies, and malocclusion of the permanent teeth.[4] A change in the Class I Angle's molar relationship of permanent teeth has also been reported.[4-6] On the other hand, Pokorná et al.[7] found that in case of premature loss of the second primary molar, space loss would occur in both upper and lower arches on the side of the lost tooth when compared to the control side. Meanwhile, the amount of space lost in the upper arch was higher than that in the lower arch. Therefore, space maintenance is important especially in the upper arch.

The weight-for-age score is a pivotal metric employed for the purpose of monitoring growth and is of paramount importance when assessing changes in malnutrition over time. The term "underweight" is used to denote a child who weighs less than would be expected for their age.[8]

Childhood physical development is critically dependent on nutritional adequacy.[9] Malnutrition, which represents a paramount global health challenge due to its pervasive and enduring sequelae, might be associated with dental occlusion disorders[10,11], particularly crowding, as it can affect the growth and development of the musculoskeletal component, including the mandible and maxilla, which in turn could reduce the space available for dental eruption, leading to inappropriate positioning of the permanent dentition in the dental arch[11-15]. However, Khan et al.[16] did not find any relationship between underweight, under height, and permanent teeth malocclusion.

Specific research that directly links extracted primary molars to subsequent occlusal changes in relation to a child's weight status is less common and represents a significant research gap. Understanding how these factors interact is crucial for a holistic approach to child health. However, little is known about how premature tooth loss interacts with nutritional status in shaping the occlusal development.

Aim

This study aimed to evaluate the impact of premature extraction of primary molars on the development of occlusal relationships and to examine its association with the weight-for-age status among children.

Materials and methods

Study design

A descriptive cross-sectional study was conducted over three months among 200 children recruited from the Department of Pedodontics and Prevention at the College of Dentistry, University of Baghdad. The study was approved by the Institutional Ethics Committee. Informed and signed consent was obtained from all parents or guardians prior to their children's participation.

Inclusion and exclusion criteria

The following criteria were applied in the selection of participants: the age of the subjects was required to range from 7 to 8 years, with the exclusion of subjects who had a history of systemic disease, physical or mental abnormalities, or orthodontic treatment. It was also necessary for the permanent first molars to have erupted. If primary molars were previously extracted, at least 6-12 months should have passed since the extraction. The remaining dentition should be healthy and free of any malformation or extensive carious lesion. Their premature loss of primary first or second molars, in either the maxilla or mandible, should be unilateral, with no premature loss on the contralateral or opposing arch.

Clinical assessment

Each child underwent a comprehensive dental examination that included dental examination, occlusal assessment, and nutritional assessment.

Dental examination: Children were examined under natural light. Premature loss of primary teeth was defined as exfoliation or extraction of a tooth before the expected eruption time of its permanent successor.

Occlusal assessment: Molar relationships were classified using Angle's classification[17] on both sides of the arch. Differences between the extraction and non-extraction sides were recorded.

Nutritional assessment: Weight status was recorded[18] using a calibrated digital scale, and the weight-for-age Z-score (WAZ) was calculated according to WHO standards using established methods according to CDC reference growth charts[19]. Children were classified as above average (> +1 SD), average (0 SD), below average (< −1 SD), and severely underweight (< −2 SD). WAZ reflects both acute and chronic malnutrition, making it suitable for monitoring growth and nutritional deficiencies.

Statistical analysis

All collected data were analyzed using the Statistical Package for Social Sciences (SPSS), version 19. Statistical analyses included percentage distributions, ANOVA, and Pearson's chi-square test. The level of significance was set at 5% (p>0.05).

Results

Out of 200 children, 150 met the inclusion criteria : 82 boys (54.7%) and 68 girls (45.3%). The mandibular primary first molar was the most lost tooth, followed by the upper second primary molar. At the same time, the least was found for the upper first primary molar (38%, 21.3%, and 20%, respectively). Meanwhile, the mandibular arch exhibited higher rates of premature loss than the maxillary arch (p<0.05) **(Fig. 1)**.

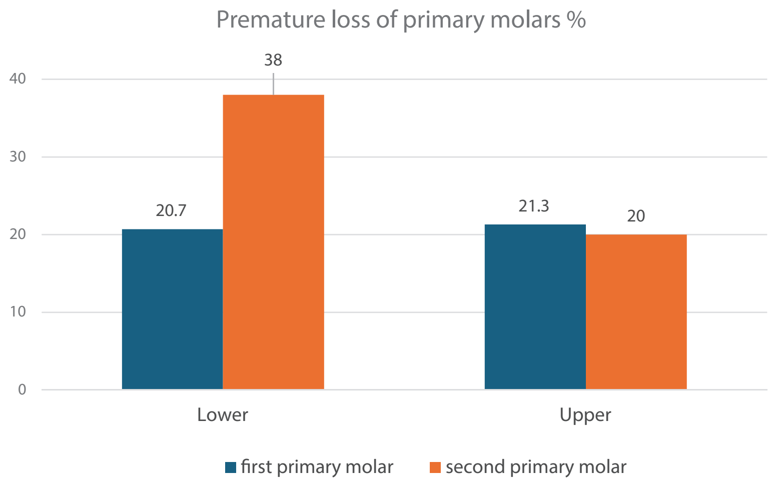

Figure 1. Distribution of premature loss of primary molars.

In terms of Angle's molar categorization among the study group, the results showed that on the side where the primary molar was lost prematurely, 37.3% of children had Class I, followed by Class II and Class III, which were evenly distributed (31.3%). However, on the control side 48% of children had Class I followed by 35.3% with Class II, and only 16.7% of children had Class III **(Fig. 2)**. An occlusal change was recorded between the extracted and the control side in 43 children (29.3% of the total sample), where 10.3% of the extracted upper and lower first primary molar showed this change (8 children) compared to 53.9% of the extracted upper and lower second primary molar (34 children).

Among the 43 children showing occlusal change between study and control sides, 12 (27.9%) had mixed classifications, including Class II on one side and Class III on the other.

The distribution of children based on WAZ percentage showed that 4% of children fell into the above-average category (above 1 SD), 46% were classified as average (0 SD), and 36.7% were below average (below −1 SD). Additionally, 13.3% of children were identified as suffering from severe underweight, defined as being below −2 SD of the reference CDC population **(Fig. 3)**.

Regarding the distribution of Angle's molar classification on the side of the premature loss of the upper first primary molar, 46.7% of children presented with Class I Angle's molar relationship, which was the highest percentage, followed by an evenly distributed percentage (26.65%) of children with Class II and Class III Angle's molar relationships. Similarly, for children who had a premature loss of the lower first primary molar, Class I Angle's molar relationship was the most prevalent (42.11%), followed by 31.57% of children with Class III and 26.32% of children with Class II Angle's molar relationship **(Table 1)**.

Meanwhile, premature loss of mandibular second molars was significantly associated with altered molar relationships, particularly a shift toward Class II or Class III on the extraction side. Regarding the premature loss of the upper

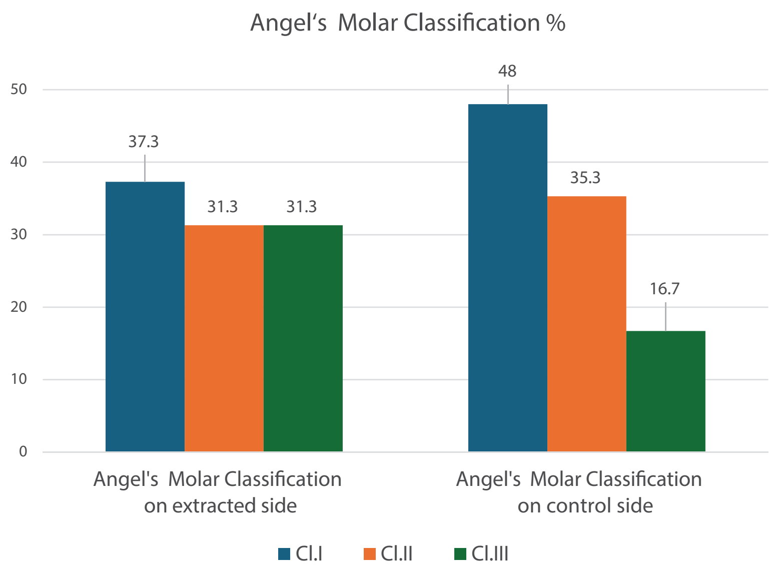

Figure 2. Distribution of Angle's molar classification.

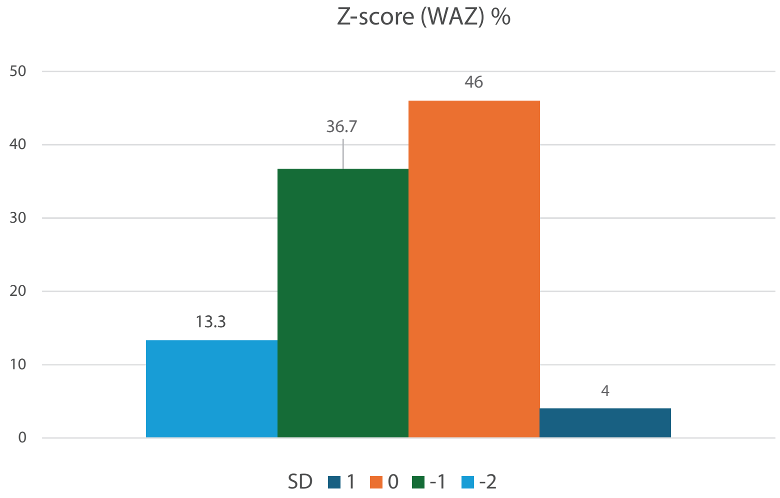

Figure 3. Distribution of children according to WAZ.

Table 1. Distribution of Angle's molar classification on the extracted side according to premature loss of primary molars

Angle's molar classification on the extracted side*	Premature loss of primary molars									
	Upper jaw (62 tooth)				Lower jaw (88 tooth)				Total	
	1st primary molar		2nd primary molar		1st primary molar		2nd primary molar			
	N	%	N	%	N	%	N	%	N	%
Class I	14	46.7	8	25	24	42.11	10	32.26	56	37.3
Class II	8	26.65	24	75	15	26.32	0	0	47	31.3
Class III	8	26.65	0	0	18	31.57	21	67.74	47	31.3
Total	30	20	32	21.3	57	38	31	20.7	150	100

* Sig $p<0.01$ among groups

second primary molar, the highest percentage of children (75%) were found to have a Class II Angle's molar relationship, and no children were found to have a Class III Angle's molar relationship. For the premature loss of the lower second primary molar, the highest percentage (67.74%) of children presented with a Class III Angle's molar relationship, and none of the children were found to have a Class II Angle's molar relationship.

Regarding the total sample, the findings showed that despite the presence of premature loss of primary molars, children with Class I Angle's molar relationship showed the highest percentage (37.3%) followed by equally distributed percentage (31.3%) for children with Class II and Class III with a statistically significant difference (Pearson chi-square=55.770, $p<0.01$).

The analysis of Angle's molar classification on the extracted side regarding WAZ showed that all children with WAZ percentages above the average (i.e., greater than 1 SD) had a Class I Angle's molar relationship. Meanwhile, most children with WAZ percentages within the average range (0 SD) had a Class I Angle's molar relationship (49.3%). On the other hand, most of those children who were severely underweight (−2 SD) were presented with Class III Angle's molar relationship (70%). A statistically significant relation was found between Angle's molar classification on the extracted side and WAZ (chi-square=37.8271, $p<0.01$), as well as the mean WAZ value was significantly low among children with Class III Angle's molar relationship ($F=16.158$, $p<0.01$) **(Table 2)**.

Distribution of Angle's molar classification on the control side, according to WAZ, showed that all children with WAZ percentages above average (more than 1 SD) presented with a Class I Angle's molar relationship. Meanwhile, most children with an average WAZ (0 SD) presented with a Class I molar relationship (65.3%), followed by 20.3% of children presenting with a Class III molar relationship. The mean value of WAZ was significantly low among children with Class II Angle's molar relationship ($F=33.665$, $p<0.01$) **(Table 3)**.

In children with a WAZ score below average (below −1 SD), the majority presented with a Class II Angle's molar relationship (54.5%), followed by 34.5% who presented with a Class I relationship. Most of those children who were severely underweight (−2 SD) were presented with Class II (75%), followed by 25% of children who were presented with Class III Angle's molar relationship **(Table 3)**.

Table 2. Distribution of Angle's molar classification on extracted side according to WAZ (ANOVA)

Angle's molar classification on the extracted side*	WAZ								Total				
	1		0		−1		−2						
	N	%	N	%	N	%	N	%	N	%	Mean ± SD	Min.	Mix.
Class I	6	100	34	49.3	16	29.1	0	0	56	37.7	−0.18±0.606	−1	1
Class II	0	0	17	24.6	24	43.6	6	30	47	31.3	−0.77±0.666	−2	0
Class III	0	0	18	26.1	15	27.3	14	70	47	31.3	−0.91±0.830*	−2	0
Total	6	4	69	46	55	36.7	20	13.3	150	100	−0.59±0.769	−2	1

WAZ: weight-for-age Z-score; * Sig. at $p<0.01$ among groups

Table 3. Distribution of Angle's molar classification on the control side according to WAZ (ANOVA)

Angle's molar classification on control side	WAZ								Total				
	1		0		−1		−2						
	N	%	N	%	N	%	N	%	N	%	Mean ± SD	Min.	Max.
Class I	6	100	47	68.1	19	34.5	0	0	72	48	−0.18±0.565	−1	1
Class II	0	0	8	11.6	30	54.5	15	75	53	35.3	−1.13±0.652*	−2	0
Class III	0	0	14	20.3	6	10.9	5	25	25	16.7	−0.64±0.810	−2	0
Total	6	4	69	46	55	36.7	20	13.3	150	100	−0.59±0.769	−2	1

WAZ: weight-for-age Z-score, Min.: minimum, Max.: maximum; * Sig. at $p<0.01$ among groups

In the total sample studied, children with a Class I Angle's molar relationship made up the largest group at 48%. Next, 35.3% of children had a Class II relationship, and 16.7% had a Class III relationship. There was a significant difference between these groups (chi-square=52.119, $p<0.01$).

Discussion

Accurate prediction of impending premature primary tooth loss would provide a crucial diagnostic tool for optimizing interceptive orthodontic strategies. Early loss of deciduous teeth may significantly compromise the development of normal occlusion, often necessitating subsequent orthodontic intervention to correct the resulting malocclusions. Disruption in the normal sequence of exfoliation can manifest as crowding, midline deviations, or altered molar relationships, collectively contributing to increased complexity and duration of future orthodontic treatment.

The present study found that the primary mandibular first molar was the most frequently lost primary tooth, a finding that is consistent with the results of other studies.[3,20-26] This higher prevalence may be attributed to its earlier eruption compared to the second primary molar, resulting in a longer period of exposure within the oral cavity.[3,21] Consequently, primary molars were commonly extracted, particularly in cases of extensive decay, reflecting a tendency among parents (caregivers) to opt for extraction over restorative treatment.[26] Importantly, clinicians often attempt to preserve second molars due to their critical role in arch stability, yet their premature loss still exerts a greater impact on occlusion.[22]

The current data set also demonstrated a greater incidence of premature tooth loss in the mandibular arch (58.7%) compared to the maxillary arch (41.3%), a trend that has been similarly reported in other studies.[20,28,29] Several synergistic factors may explain this disparity. The anatomical configuration of the mandibular posterior region often retains food debris and promotes the accumulation of plaque biofilm accumulation. This localized environment creates a more significant cariogenic challenge. Conversely, maxillary molars typically benefit from enhanced salivary flow, which provides a protective anti-cariogenic effect due to its inherent buffering capacity, remineralization potential, and antimicrobial properties.[27]

A significant difference in Angle's molar classification was identified between the side where teeth were removed and the side where they were not. Specifically, 10.3% of children who lost their first primary molar early showed this difference. In contrast, 53.9% of children who lost their second primary molar earlier had the same issue. This suggests that premature loss of primary teeth, particularly mandibular molars, significantly increases the risk of occlusal disturbances. These findings support previous reports linking early tooth loss with space reduction, crowding, and altered molar relationships.[7,26]

In the present study, nearly one-third of children exhibited a discrepancy between extracted and control sides, with 27.9% presenting mixed classifications (e.g., Class II on one side and Class III on the other). Such asymmetry underscores that the effect of premature molar extraction is not always bilateral and may result in side-specific malocclusions. This finding aligns with earlier reports suggesting that unilateral premature loss can disturb occlusal balance and contribute to functional asymmetry.[7,30] Clinically, this highlights the importance of early space maintenance and monitoring to prevent unilateral occlusal discrepancies.

Further analysis revealed that 75% of children with premature loss of the upper second primary molar had a Class II molar relationship, the highest percentage compared to the effect of premature loss of primary molars on Angle's molar relationship. These results agree with Pokorná et al.[7], who found that after premature loss of the upper second primary molar in the upper arch, the mesial tooth movement changed the intermolar relationship towards the Angle Class II tendency, which was more clinically relevant in the upper arch than the lower arch. This might be due to considerable mesial rotation of the first molars around the palatal root.

Similarly, 67.74% of children who experienced premature loss of the lower second primary molar exhibited a Class III molar relationship, a pattern also reported in earlier studies.[7,30] Premature loss of the lower second primary molar and the subsequent mesial movement of the permanent molars might lead to mesiocclusion.[30]

Weight-for-age (WAZ) was employed in the present study as an indicator of nutritional status because the weight is easy to measure and reflects both acute and chronic malnutrition.[8,31,32]

Nutritional status emerged as a key modifier. Most children whose mean value of WAZ was below average (below −1 SD, −2 SD) were more likely to present with malocclusion tendencies (Class II or Class III molar relationships), suggesting an interaction between systemic and local factors. There were many factors that might affect children's somatic and dental growth such as genetic, non-genetic, and environmental factors.[33] Non-genetic factors included birth weight, diseases, and nutritional status. A good diet is one of the most essential factors required for somatic growth. Craniofacial and dental growth with somatic growth may be affected also[12,15,34,35], so malnutrition restricts craniofacial growth, reduces arch dimensions, and predisposes to occlusal anomalies[12].

On the other hand, on the extracted side, most children who were severely underweight (−2 SD) exhibited a Class III Angle's molar classification; this might be due to the presence of local factors of premature loss of primary teeth, which directly affects Angle's molar classification on the extracted side.

In addition, malnutrition acts as a risk factor for enamel and dental caries[36,37], which may increase the likelihood of premature tooth extraction, thus compounding the risk of malocclusion.[38] Moreover, poor nutrition causes delays in the maturation of bone, which increases the risk of malocclusions.[11] Findings of the present study therefore support a multifactorial pathway in which nutritional deficiency not only directly affects growth but also indirectly influences occlusal development through caries-related tooth loss.

The integration of systemic (nutrition) and local (tooth loss) factors underscores the multifactorial etiology of malocclusion. Early preventive measures, including dietary counseling, caries prevention, and timely use of space maintainers are essential.

Conclusions

Premature loss of primary molars, particularly second molars, significantly alters occlusal development. Undernutrition further increases malocclusion risk, especially Class II (maxilla) and Class III (mandible). Preventive oral health care should be integrated with nutritional monitoring to reduce future orthodontic burden.

Ethical approval

The study protocol was approved by the research Ethics Committee at the College of Dentistry, University of Baghdad (Ref. No. 1049) of May 13, 2025.

Ethical statements

The authors declared that no clinical trials were used in the present study.

The authors declared that no experiments on humans or human tissues were performed for the present study.

The authors declared that all parents or guardians provided written informed consent before enrolling their children in the study.

The authors declared that no experiments on animals were performed for the present study.

The authors declared that no commercially available immortalized human and animal cell lines were used in the present study.

Conflict of interest

The authors have declared that no competing interests exist.

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Use of AI

No use of AI was reported.

Data availability

All data used are referenced or included in the article.

Author contributions

MOA: study conception and design of the study and data collection; AHMJ: methodology; MOA, AHMJ, and NJR: statistical analysis and interpretation of results; AHMJ: original draft manuscript preparation, writing and editing. All authors reviewed the results and approved the final version of the manuscript to be published.

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