

Early Growth Trajectories of Infants with Cleft Lip and Palate Receiving Digital NAM: Comparison with WHO Standards

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Introduction

Cleft lip and palate (CLP) is a common congenital anomaly associated with feeding difficulties, increasing the risk of inadequate nutrition and growth faltering during early infancy. Since the first 1,000 days of life are critical for growth and neurodevelopment, monitoring growth is essential. Digital Nasoalveolar Molding (Digital NAM) has been introduced to improve presurgical treatment and may enhance feeding efficiency; however, evidence regarding early growth outcomes remains limited. Therefore, this study aimed to evaluate the early growth trajectories of infants with CLP receiving Digital NAM treatment and compare them with the WHO Child Growth Standards.

Methods

A prospective cohort study was conducted among 12 infants at Cleft Center of Excellence in Northeastern Thailand. Treatment was initiated at ≤ 4 weeks of age. Data on feeding methods, appliance care, and growth parameters (weight, length, and head circumference) were collected at three time points (approximately 1, 2-3, and 5-6 months of age). Data were analyzed using descriptive statistics and Mixed-effects REML regression.

Results

The majority of participants were male (58.33%), with unilateral complete cleft lip and palate (91.67%) (Table 1). Caregivers demonstrated good appliance management skills that improved progressively over time, with a low incidence of complications (Table 2). Feeding was predominantly accomplished through alternative methods, with direct breastfeeding remaining limited. Infant weight increased significantly over time, with age identified as a significant predictor of weight gain. Mixed formula feeding via bottle showed a positive trend, although this did not reach statistical significance. Notably, caregiver skill in device-assisted feeding—particularly during the phase involving the nasal and alveolar molding appliance—was significantly associated with weight gain (Table 3 and 4).

Table 1. Baseline Characteristics of Infants with CLP (n = 12)

Characteristic	Value
Age (weeks)	9.5 $\pm$ 5.6
Birth weight (g)	2,948 $\pm$ 418
Male	58.3%
Female	41.67%
Unilateral CLP	91.67%
Expressed breast milk	66.7%

Table 2. Caregiver Competency During Digital NAM Treatment

Outcome	T1	T2	T3
Caregiver competent in palatal plate management	33.3	83.3	75.0
Appliance complications	Low	Low	Low

Table 3. Changes in Growth Parameters

Variable	T1	T2	T3
Weight (g), mean $\pm$ SD	4,360 $\pm$ 839.91	5,145.83 $\pm$ 852.91	6,716.33 $\pm$ 1,017.12
Weight-for-Age Z-score	≈ -1.2 to -1.5	≈ -1.2	≈ -1.0 to -1.3
Length (cm), mean $\pm$ SD	55.5 $\pm$ 3.43	58.71 $\pm$ 4.36	62.43 $\pm$ 4.46

Table 4. Factors Associated with Infant Weight Gain

Predictor	β	P
Time point 2	693.6	0.001
Time point 3	1,287.6	< 0.001
Age (weeks)	66.4	< 0.001
Poor supplemental feeding skill	$\downarrow$ Weight	< 0.05

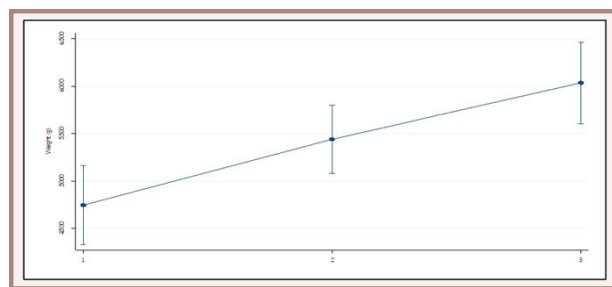


Figure 1: Weight trajectory over time, adjusted for the influence of other variables

Discussion

Infants with CLP receiving Digital NAM showed continuous improvement in weight, length, and head circumference throughout follow-up. Although weight-for-age remained slightly below the WHO reference, growth stayed within the normal range, suggesting that nutritional status was adequately maintained. Caregiver competency in appliance management improved over time, while appliance-related complications were minimal, highlighting the importance of caregiver education and multidisciplinary support. These findings suggest that Digital NAM, combined with continuous nutritional monitoring and family-centered care, may promote favorable early growth in infants with CLP.

Conclusion

Infant growth was associated with both biological factors and caregiver competency, reflecting the importance of holistic, family-centered care. These findings are consistent with WHO principles emphasizing comprehensive care and a family-centered approach.

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