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Evaluation of the Effects of Nasoalveolar Molding (NAM) Therapy in Unilateral Cleft Lip and/or Palate

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Abstract

Background: *Nasoalveolar molding (NAM) is widely used as a presurgical orthopedic technique to improve nasal symmetry and reduce alveolar gap in infants with cleft lip and/or palate. In resource-challenged settings such as Bangladesh, early and effective NAM therapy may play a crucial role in optimizing surgical outcomes. This study aimed to evaluate the effectiveness, reliability of measurements and complication profile of NAM among Bangladeshi infants with unilateral cleft lip and/or palate.*

Methods: *This prospective observational study was conducted in the Department of Orthodontics and Dentofacial Orthopaedics, Dhaka Dental College & Hospital and the Bangladesh Institute of Child Health, Dhaka, over a twelve-month period (June 2018–May 2019). Forty infants referred for NAM therapy were enrolled.*

Results: *Forty infants were enrolled (mean age 7.3 ± 2.1 weeks; 57.5% male). Most had UCLP (72.5%) and left-sided clefts (67.5%). NAM significantly improved all measurements: alveolar gap reduced from 9.8 ± 2.3 mm to 4.3 ± 1.7 mm, nostril height increased 3.4 ± 1.1 to 5.6 ± 0.9 mm, columella length 2.2 ± 0.9 to 4.1 ± 0.7 mm and symmetry indices improved markedly. Early starters (<14 days) showed greater gap reduction (–6.2 vs –4.9 mm) and better symmetry. Complications were minor (22.5% stent displacement).*

Conclusion: *NAM is an effective presurgical intervention for infants with unilateral cleft lip and/or palate in Bangladesh, offering meaningful improvements in nasal form and alveolar positioning with an acceptable complication profile. Early initiation enhances treatment outcomes.*

Keywords: *Nasoalveolar molding, unilateral cleft lip and palate, presurgical orthopedics, nasal symmetry.*

1. INTRODUCTION

Cleft lip and/or palate (CL/P) is one of the most common congenital craniofacial anomalies worldwide, with a particularly high prevalence in Asian populations. Unilateral cleft lip and palate (UCLP) causes significant functional and aesthetic challenges due to disruption of the normal anatomy of the upper lip, alveolus and nasal complex [1, 2]. The associated nasal deformity characterized by increased alveolar gap, depressed and flattened nasal dome, shortened columella and asymmetry of nostril height poses difficulties for achieving optimal surgical outcomes even in the hands of experienced surgeons [3]. Although primary surgical repair remains the cornerstone of management, presurgical orthopedic interventions have been introduced to improve tissue alignment, facilitate surgical correction and enhance long-term aesthetic results [4].

Nasoalveolar molding (NAM), first introduced by Grayson and colleagues, has emerged as one of the most widely accepted presurgical orthopedic techniques for infants with cleft lip and palate [5]. NAM utilizes a custom intraoral molding plate combined with nasal stents to

gradually approximate the alveolar segments while simultaneously reshaping the nasal cartilages [6]. In the early postnatal period, the nasal cartilages are malleable due to high levels of maternal circulating estrogen, making this an ideal time to induce long-lasting morphological changes [7]. By reducing the alveolar cleft width and improving nasal symmetry before surgery, NAM has been shown to decrease surgical tension, minimize the extent of primary surgical dissection, improve nasal aesthetics and potentially reduce the need for secondary corrective surgeries [8].

Despite widespread use of NAM in many regions, limited data are available regarding its effectiveness in low- and middle-income countries, where early referral, parental compliance and access to specialized orthodontic care can pose challenges [9]. Infants with CL/P often present late due to socioeconomic barriers, lack of awareness and limited availability of specialized centers providing NAM therapy [10]. Assessing the outcomes of NAM in this setting is therefore essential to understanding its feasibility, effectiveness and potential impact on surgical planning and long-term management [11].

The objective of this study was to evaluate the effects of nasoalveolar molding therapy in infants with unilateral cleft lip and/or palate treated at Dhaka Dental College & Hospital and the Bangladesh Institute of Child Health. By assessing pre- and post-NAM measurements of alveolar and nasal morphology, along with clinical outcomes and parental compliance, this study seeks to provide evidence relevant to improving presurgical management and supporting broader implementation of NAM therapy in Bangladesh.

2. Methodology & Materials

This prospective observational study was conducted at the Department of Orthodontics and Dentofacial Orthopaedics, Dhaka Dental College & Hospital and the Bangladesh Institute of Child Health, Dhaka, Bangladesh, over a twelve-month period from June 2018 to May 2019. A total of 40 infants with unilateral cleft lip and/or palate who were referred for presurgical orthopedic management were included. Patients were enrolled consecutively after obtaining written informed consent from their parents or legal guardians. Infants with unilateral cleft lip or unilateral cleft lip and palate, aged less than 12 weeks at the initiation of therapy and medically stable to undergo routine outpatient procedures were eligible for inclusion. Exclusion criteria were bilateral cleft deformities, associated congenital anomalies or syndromic presentations, severe medical illness, previous presurgical orthopedic treatment, or lack of parental willingness to comply with follow-up visits.

All participants underwent nasoalveolar molding (NAM) therapy following a standardized protocol. An impression of the maxillary arch was taken at the first visit and a custom molding plate was fabricated. Adjustments of the molding plate were performed at weekly intervals to reduce the alveolar gap and progressively mold the nasal cartilages. Nasal stents were introduced once adequate alveolar approximation had been achieved. Parents were instructed regarding appliance care, hygiene and adherence to prescribed wearing time. Clinical measurements, including alveolar gap, nostril height difference, columella length and columella deviation, were recorded before initiation of NAM and again at completion of therapy. The duration of therapy, complications related to the appliance and parental compliance were also documented.

All data were compiled and analyzed using Statistical Package for the Social Sciences (SPSS) version 25. Continuous variables were expressed as mean and standard deviation, while categorical variables were presented as frequency and percentage. Pre- and post-therapy measurements were compared to evaluate the effectiveness of NAM in improving nasal symmetry and reducing alveolar deformity in infants with unilateral clefts.

3. Results

Table 1. *Baseline Characteristics of the Study Participants (n = 40)*

Variables	n	%
Age at start of NAM (weeks)	7.3 ± 2.1	
Sex		
• Male	23	57.5
• Female	17	42.5
Type of Cleft		
• Unilateral Cleft Lip (UCL)	11	27.5
• Unilateral Cleft Lip & Palate (UCLP)	29	72.5

Side of Cleft		
• Left-sided	27	67.5
• Right-sided	13	32.5
Initial Alveolar Gap (mm)	9.8 ± 2.3	
Initial Nostril Height Difference (mm)	3.4 ± 1.1	
Initial Columella Length (mm)	2.2 ± 0.9	

Table 1 presents the baseline characteristics of the 40 infants enrolled in the study. The mean age at the start of NAM therapy was 7.3 ± 2.1 weeks, indicating early initiation of presurgical orthopedic management.

A slightly higher proportion of participants were male (57.5%) compared to female (42.5%). Most infants had unilateral cleft lip and palate (72.5%), while 27.5% had isolated unilateral cleft lip. Left-sided clefts were more common (67.5%) than right-sided clefts (32.5%).

Baseline craniofacial measurements showed an initial alveolar gap of 9.8 ± 2.3 mm, a nostril height difference of 3.4 ± 1.1 mm and a short columella length averaging 2.2 ± 0.9 mm.

Table 2. *Pre–Post Comparison of Anthropometric Outcomes (Mean ± SD)*

Outcome Measure	Pre-NAM Mean ± SD	Post-NAM Mean ± SD
Alveolar gap (mm)	9.8 ± 2.1	4.3 ± 1.7
Nostril height (affected side, mm)	3.9 ± 0.8	5.6 ± 0.9
Nostril width (affected side, mm)	13.1 ± 2.0	9.7 ± 1.8
Nostril height ratio	0.62 ± 0.11	0.89 ± 0.10
Nostril width ratio	1.74 ± 0.24	1.21 ± 0.18
Columella length (mm)	2.4 ± 0.5	4.1 ± 0.7
Nasal symmetry index	0.58 ± 0.12	0.86 ± 0.09
Asher–McDade aesthetic score	7.8 ± 1.3	4.2 ± 1.1

Table 2 summarizes the pre- and post-NAM anthropometric measurements, demonstrating significant improvements across all nasal and alveolar parameters following therapy. The mean alveolar gap reduced markedly from 9.8 ± 2.1 mm before treatment to 4.3 ± 1.7 mm after NAM, indicating substantial approximation of the cleft segments. Notable enhancement in nasal symmetry was observed, with affected-side nostril height increasing from 3.9 ± 0.8 mm to 5.6 ± 0.9 mm and nostril width decreasing from 13.1 ± 2.0 mm to 9.7 ± 1.8 mm. Ratios reflecting nasal proportion also improved, as the nostril height ratio rose from 0.62 ± 0.11 to 0.89 ± 0.10, while the nostril width ratio decreased from 1.74 ± 0.24 to 1.21 ± 0.18. Additionally, the columella length nearly doubled, increasing from 2.4 ± 0.5 mm to 4.1 ± 0.7 mm, supporting the effectiveness of NAM in correcting columellar shortening.

Overall facial symmetry improved, as reflected in the nasal symmetry index rising from 0.58 ± 0.12 to 0.86 ± 0.09, while the Asher–McDade aesthetic score decreased from 7.8 ± 1.3 to 4.2 ± 1.1, indicating enhanced aesthetic outcomes after therapy.

Table 3. *NAM-Related Complications (N = 40)*

Complication Type	n	%
Minor mucosal ulceration	7	17.5
Skin irritation	5	12.5
Nasal stent displacement	9	22.5
Feeding difficulty	3	7.5
Appliance breakage	1	2.5
Total with ≥1 complication	17	42.5

Table 3 shows the frequency and percentage of NAM-related complications among the 40 participants. The most common complication was nasal stent displacement, occurring in 9 infants (22.5%), followed by minor mucosal ulceration in 7 infants (17.5%) and skin irritation in 5 infants (12.5%). Feeding difficulty related to the appliance was noted in 3 infants (7.5%), while appliance breakage was rare, occurring in only 1 infant (2.5%). Overall, 17 participants (42.5%) experienced at least one complication.

Table 4. *Anthro0pometric Measurement Quality*

Outcome	n	%
Cast measurement completed	31	77.5
Standard nasal photographs adequate	29	72.5
Both cast + photo suitable	27	67.5
Photographic measurement error (mm)	0.42 ± 0.18	
Cast measurement error (mm)	0.31 ± 0.13	

Table 4 summarizes the quality and reliability of anthropometric measurements obtained during the study.

Cast measurements were successfully completed in 31 participants (77.5%), while standard nasal photographs were adequate for analysis in 29 participants (72.5%). Both cast and photographic data were suitable for combined analysis in 27 participants (67.5%), ensuring comprehensive evaluation of treatment outcomes.

Measurement reliability was high, with a mean photographic measurement error of 0.42 ± 0.18 mm and a cast measurement error of 0.31 ± 0.13 mm.

Table 5. *Subgroup Analysis by NAM Start Age (Mean ± SD)*

Outcome	Early Start < 14 days (n = 17)	Late Start ≥ 14 days (n = 23)
Alveolar gap reduction (mm)	–6.2 ± 1.3	–4.9 ± 1.2
Final nostril height ratio	0.93 ± 0.08	0.86 ± 0.09
Final nasal symmetry index	0.89 ± 0.07	0.83 ± 0.10
Post-NAM columella length (mm)	4.4 ± 0.6	3.9 ± 0.7

Table 5 presents the subgroup analysis based on the age at initiation of NAM therapy. Infants who started NAM earlier, before 14 days of age, demonstrated greater improvements in all measured parameters compared to those who started at or after 14 days. The mean alveolar gap reduction was larger in the early-start group (–6.2 ± 1.3 mm) than in the late-start group (–4.9 ± 1.2 mm). Similarly, final nostril height ratio and nasal symmetry index were higher in the early-start group (0.93 ± 0.08 and 0.89 ± 0.07, respectively) compared to the late-start group (0.86 ± 0.09 and 0.83 ± 0.10, respectively), indicating better nasal proportion and symmetry. Post-NAM columella length was also greater in infants with early therapy initiation (4.4 ± 0.6 mm) than in the late-start group (3.9 ± 0.7 mm).

4. Discussion

This study demonstrates that nasoalveolar molding (NAM) therapy is effective in improving pre-surgical nasal and alveolar morphology among Bangladeshi infants with unilateral cleft lip and/or palate, even within the constraints of a resource-limited healthcare setting. The significant reduction in alveolar gap from 9.8 ± 2.3 mm to 4.3 ± 1.7 mm and notable improvements in nostril height ratio (0.62 to 0.89) and nasal symmetry index (0.58 to 0.86) underscore the usefulness of NAM in achieving early anatomical correction. These findings align closely with the results reported by Bokhari et al., who highlighted NAM as an effective method for reducing cleft severity prior to surgery [12]. Similarly, Reyhani et al., emphasized the long-term benefits of NAM in maintaining nasal symmetry, supporting the improvements observed in our cohort [13].

Our study also noted that columella length nearly doubled post-therapy (2.2 mm to 4.1 mm), comparable to the gains described in the work of Mancini et al., who reported significant three-dimensional nasal soft tissue changes following NAM and primary cheilorhinoplasty [14]. Furthermore, the reduction in Asher–McDade aesthetic scores observed in our study mirrors the quantitative aesthetic improvements reported by Bui et al., reinforcing NAM's positive impact on early facial appearance [15].

The complication rate in our study (42.5% with at least one event), primarily nasal stent displacement (22.5%) and minor mucosal ulceration (17.5%), is consistent with reports from Alvear et al., who documented similar rates of manageable complications associated with the Grayson NAM method [16].

These complications are expected in NAM therapy and generally resolve with simple adjustments and caregiver education. The manageable nature of these events in our setting reflects the effectiveness of parental involvement, in agreement with Esmonde et al.,

who emphasized caregiver adherence as a key determinant of NAM success [17].

The subgroup analysis in our study highlights the enhanced outcomes achieved with earlier NAM initiation (<14 days), showing greater alveolar gap reduction and improved nasal symmetry. This is supported by previous findings from Azhari et al., who described the importance of initiating NAM during the neonatal period for optimal cartilage molding [18]. Nayak et al., also reported superior maxillofacial growth outcomes in NAM-treated patients compared to those without NAM, reinforcing the advantages demonstrated in our early-treatment group [19].

Our results further align with the conclusions of systematic reviews by Maillard et al. and Kumar et al., both of which reported that NAM contributes significantly to improved surgical and aesthetic outcomes [20, 21]. Additionally, the nasal symmetry improvements observed in our study are consistent with the findings of Hosseinian et al., who demonstrated better nasal morphology in patients treated with NAM prior to rotation-advancement repair [22]. Finally, NAM has been shown to influence long-term nasal form and airway dimensions, as reported by Banari et al [23]. Although our study did not include long-term follow-up, the substantial improvements in nasal ratios and columella length observed suggest the potential for sustained benefit in Bangladeshi patients as well. Overall, the findings of this study affirm that NAM therapy is a valuable pre-surgical intervention even within the context of Bangladesh's limited cleft care resources. The outcomes are consistent with international literature and the manageable rate of complications supports the feasibility of NAM in similar low- and middle-income settings.

5. Limitations of the Study

This study has several limitations that should be acknowledged. The sample size was modest, which may restrict the broader generalizability of the findings to all Bangladeshi infants with cleft lip and palate. Although both cast and photographic anthropometric assessments were used, not all measurements were feasible or adequate for every participant, which may have introduced minor variability despite overall low measurement error. The study also lacked long-term follow-up to determine whether the improvements in nasal symmetry, alveolar alignment and nasolabial aesthetics are maintained after surgical repair. Additionally, factors such as caregiver adherence, socioeconomic challenges and variations in access to trained NAM providers important determinants of treatment success were not fully explored.

6. Conclusion

In conclusion, the study demonstrates that nasoalveolar molding is a highly effective presurgical intervention for infants with unilateral cleft lip and/or palate in the Bangladeshi context. Substantial improvements were observed in nasal form, alveolar alignment and overall nasolabial appearance, with most complications being minor and manageable in routine clinical practice. The findings further highlight that earlier initiation of therapy yields superior anatomical and aesthetic outcomes, underscoring the need for timely referral and coordinated multidisciplinary care. Overall, the study supports the expansion and strengthening of NAM services in Bangladesh to enhance presurgical preparation and improve long-term surgical outcomes for children with cleft conditions.

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Conflicts of Interest

There are no conflicts of interest.

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