

# WEST AFRICAN JOURNAL OF ORTHODONTICS

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**Bilateral cleft lip and palate treated with clear aligners**

# A Case of Bilateral Cleft of the Lip Alveolus and Palate treated with Presurgical Infant Orthopaedics using Clear Aligners

Odunsi O,<sup>b,\*</sup> Yemitan T,<sup>a,b</sup> Oyewo O<sup>b</sup>

## Abstract

### Abstract

A case report on presurgical infant orthopaedic management of a 1-day-old male patient with a bilateral cleft of the lip and palate, widely separated lip segments, rotated premaxilla, significantly increased alar base width, flattened nasal tip and a severely deficient columella using clear aligners.

Treatment objectives were to reduce the size of the cleft defect, lengthen the columella, improve nasolabial aesthetics and improve the outcome of surgical repair.

After a thorough patient assessment, presurgical infant orthopaedic treatment using the NAM aligner system incorporating nasal hooks and lip taping was planned. The treatment was carried out over a period of 12 weeks, with nasal moulding initiated after six weeks of aligners therapy using a nasal hook in conjunction with the NAM aligner.

After 12 weeks of presurgical infant orthopaedic treatment, the size of the cleft defect was significantly reduced, nasolabial aesthetics was improved and a significant increase in the columella length was achieved.

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## Introduction

Presurgical infant orthopaedics (PSIO) was introduced in the early 1900s with the primary objective of correcting the malpositioned alveolus before primary surgery in patients born with cleft lip and palate.<sup>1,2</sup> The concept of nasoalveolar moulding began to gain popularity in the 1950s, this was validated by the findings of Matsuo who reported that the nasal cartilage could be

moulded, due to increased lack of elasticity from increased levels of maternal oestrogen, if treatment is initiated within 6 weeks of life.<sup>3,4</sup>

Different techniques of presurgical infant orthopaedics have been recorded. These include alveolar moulding, lip strap, nasoalveolar moulding (NAM), and lip adhesion.<sup>5,6</sup> The NAM appliance consists of two components: an intraoral moulding plate and the nasal component, to align and approximate the alveolus as well as mould the distorted nasal cartilage concurrently.<sup>1,5</sup> Moulding can be achieved using active appliances that move the separate alveolar processes into position by applying active forces on them, or by a passive appliance which allow the passive growth of alveolar processes as planned by the clinician.<sup>5</sup> Grayson<sup>7</sup> introduced the passive NAM technique, describing it as one that involved passive moulding while simultaneously repositioning the deformed nasal cartilages and alveolar processes as well as the lengthening of the

deficient columella. This technique has been subjected to modifications aimed at improving infant and caregiver comfort as well as treatment outcomes.<sup>8-10</sup>

The use of clear aligners for orthodontic tooth movement was introduced in 1997 by Align Technology (Santa Clara, California), and their use has been increasing, mostly in adult patients.<sup>11</sup> In 2019, Batra *et al*<sup>12</sup> reported the use of clear aligners with nasal stents for presurgical infant orthopaedics which yielded promising results while increasing the comfort and convenience of the patients. They, however, reported that the use of clear aligners was at an additional cost when compared with other PSIO techniques. This case report demonstrates the treatment of a case of bilateral cleft of the lip, palate, and alveolus, with presurgical infant orthopaedics, using clear aligners.

### Presenting complaint

A day-old male patient, weight 2.90kg presented at the orthodontic clinic of the Department of Child Dental Health, Lagos State University Teaching Hospital, Lagos (LASUTH), with the chief complaint of abnormal lip and hole in the mouth, made by the parents.

### Medical, Family and Social History

Pregnancy history revealed that the mother was treated for malaria around 16 weeks of gestation. He was the last of 4 children. The father was a 36-year-old laundry man, while the mother was a 31-year-old housewife. There was no positive history of cleft among the nuclear and extended families, and neither of the parents smoked or consumed alcohol.

### Diagnosis

Examination showed bilateral cleft of the lips, palate and alveolus. The premaxilla was rotated, a cleft gap of 15.4 mm at lip level and 8 mm at the alveolar ridge level was observed on the right and a cleft gap of 13.2 mm at lip level and 5.9 mm at the alveolar ridge level was observed on the left. The ala and columella of the nose were collapsed. A total nostril width of 41 mm and a nostril height of 2 mm were recorded. All linear measurements were performed on clinical photographs (Figure 1) incorporating a millimeter scale to aid image calibration and prevent magnification errors using Adobe Photoshop 2020 v21.0.2.57 (Adobe Inc, San Jose, California).



**Figure 1:** Pretreatment extra oral and intra-oral photographs

## Treatment Objectives

The treatment objectives were:

1. To reduce the size of the cleft defect.
2. To improve the nasolabial aesthetics by approximate bilateral lip tissues, reduce the width of the nasal tip, improved nasal tip projection, and reduce nasal alar base width.
3. To lengthen the columella.
4. To align and approximate the intraoral alveolar cleft segments.
5. To improve the outcome of surgical repair of the cleft defect.

## Treatment alternatives

Four alternatives were presented to the parents;

1. Extraoral lip taping to reduce the size of the cleft defect. The intraoral alveolar cleft defect will not be aligned and approximated, neither will nasolabial aesthetics be improved.
2. Extraoral lip taping combined with nasal stents to reduce the size of the cleft defect and lengthen the columella. The limitation was that the intraoral alveolar cleft segments will not be aligned nor approximated.
3. Presurgical infant orthopaedics using acrylic NAM appliance to reduce the size of the cleft defect, improve nasolabial aesthetics and align and approximate alveolar cleft defects. The disadvantages are the multiple visits required for laboratory trimming of the appliance with treatment progression, the bulky size of the acrylic baseplate plate, and the risk of adverse reactions to the acrylic plate.
4. Presurgical infant orthopaedics using NAM aligner system incorporating nasal stents and lip taping to reduce the size of the cleft defect, improve nasolabial aesthetics, and align and approximate alveolar cleft defects. This option eliminates the multiple visits for laboratory trimming, and is more comfortable for the infant without the risk of adverse reactions to

acrylic. However, the limitation is in the cost of the aligners.

After a review of the risks and benefits of the options, the parents chose the more convenient method which was the fourth alternative based on the advantages of being more comfortable for the infant and easier on the parents.

## Appliance fabrication

### Impression Taking

An initial impression was taken with rubber-based impression material (Imprisil, Pyrax, India) using an acrylic stock tray (Figure 2(A)) with the help of a clinical assistant. The impression was taken in the orthodontic clinic, LASUTH. The infant was positioned inverted on the mother's lap and stabilized gently with the clinical assistant's hand. The heavy-bodied material was placed on the acrylic stock tray covered with a separator and the impression tray was seated in the infant's mouth to set according to the manufacturer's instructions. The impression was withdrawn and the infant's oral cavity was examined for the presence of residual impression materials. Thereafter, the separator was removed and the light body mix was syringed over the heavy-bodied impression and gently inserted into the infant's mouth and allowed to set according to the manufacturer's instructions. The set impression was withdrawn and the infant's mouth was suctioned to ensure no left-over impression material. The infant was observed to have cried throughout the process and was checked continuously for any signs of distress.

A thermoplastic special tray was fabricated from the initial impression and used to record the secondary impression (Figure 2(B)) using a rubber-based impression material (Imprisil, Pyrax, India) and the putty, followed by the light body mix in the orthodontic clinic, LASUTH.



**Figure 2:** Photographs of rubber-based impressions. (A: Initial impression taken with an acrylic stock tray; B: Secondary impression taken with a thermoplastic special tray)

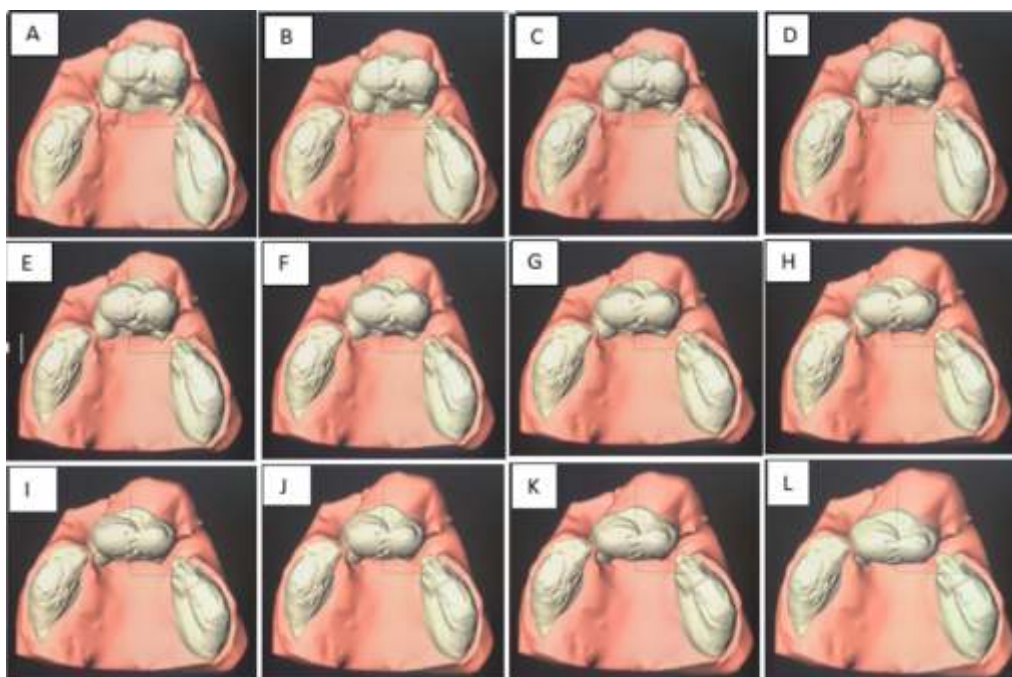
**Aligners' Fabrication**

A three-dimensional (3-D) model of the maxilla was made by laser-scanning the plaster model poured from the impression (Desktop Laser Scanner, Ortho Insight 3D®, TN, USA).

Using Ortho Insight 3-D software, a virtual set-up was made from the model separating the major and minor cleft segments. The number of stages required

to gradually mold the segments was determined based on the amount of movement desired to produce the desired results, without exceeding 1mm per stage (Figure 3).

The set-up was exported in STL file format to a 3D printer (Sprintray Pro 3D printer, CA, USA) for manufacturing, using the Die and Model 2 Gray resin (Sprintray, CA, USA).



**Figure 3:** Photographs showing 3-D models of the maxilla (A - model for aligner 0; B - model for aligner 1; C - model for aligner 2; D - model for aligner 3; E - model for aligner 4; F - model for aligner 5; G - model for aligner 6; H - model for aligner 7; I - model for aligner 8; J - model for aligner 9; K - model for aligner 10; L - model for aligner 11)

### Treatment Progress

Presurgical infant orthopaedics treatment began on the 10<sup>th</sup> of June, 2021 with the insertion of NAM aligner 0 (Figure 4). The aligners were retained naturally and retention was enhanced with denture adhesive (Fixodent, Procter and Gamble, OH, USA). On the same day, extra oral lip taping (Steri strip™, 3M Health care, MN, USA) was done and hydrocolloid dressing (DuoDERM\*, ConvaTec, United Kingdom) to protect the infant's skin from irritation (Figure 4). Parents were taught lip taping and tapes were changed 2-4 times a day after feeding or whenever the tapes peeled off, to ensure continuous orthopaedic force. The parents were also trained to insert, remove, and clean the aligners. They were also instructed to keep the aligner in the mouth throughout the day and night including during feeding and to clean the aligner twice daily with a soft toothbrush and gently wipe the oral cavity with cotton wool and lukewarm water. Aligners were changed weekly in incremental steps. The patient was recalled every two weeks.



**Figure 4:** Extraoral photographs showing aligner and extraoral lip taping.

After six weeks of aligners therapy, nasal moulding was initiated using a nasal hook along with the NAM aligner (Figure 5). Nasal moulding of the cartilage commenced using a stent in the form of an acrylic hook in each nostril taped to the forehead with hydrocolloid dressing protection over the skin. The

magnitude of the force was determined based on whether the nose tip turned white, if not, the force was increased. The tape connecting the nasal hook and the forehead was changed daily to make sure that the orthopaedic force was strong enough to elevate the nasal tip.



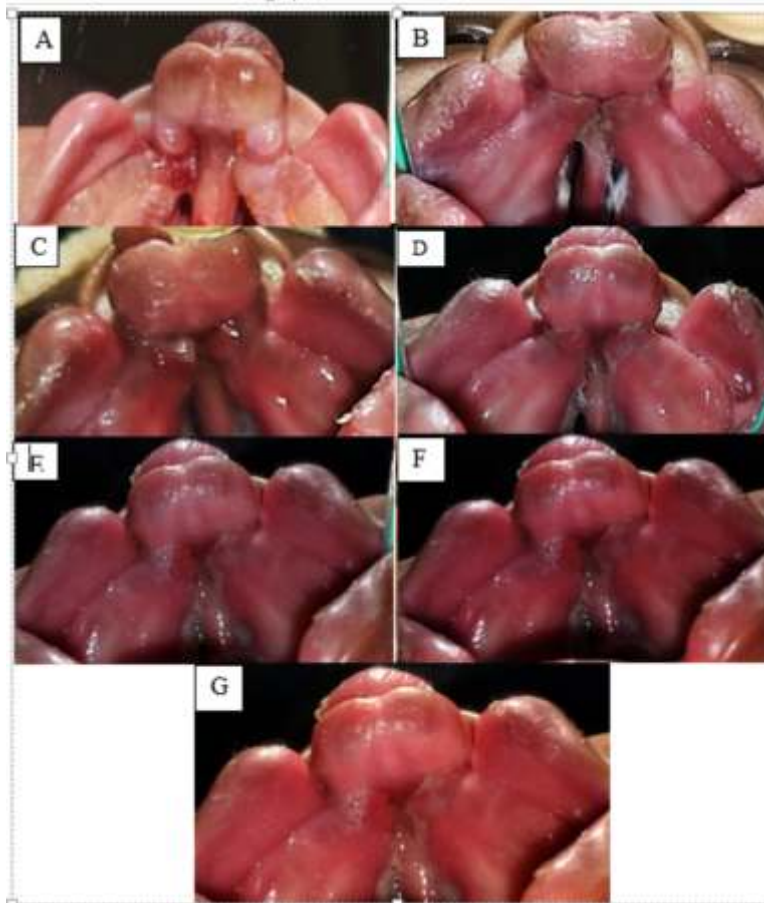
**Figure 5:** Patient at six weeks, showing commencement of the use of nasal hooks

### Treatment results

The treatment was completed over a period of 12 weeks (3 months). Figure 6 shows treatment progress for the course of the treatment.

The size of the cleft defect was significantly reduced, the nasolabial aesthetics was improved, alignment and approximation of the intraoral alveolar cleft segments were achieved and a significant increase in the columella length was achieved, (Figure 7).

The post-treatment linear measurements are shown in Table 2. Linear measurements were performed on clinical photographs incorporating a millimetre scale using Adobe Photoshop 2020 v21.0.2.57 (Adobe Inc, San Jose, California) to aid image calibration and prevent magnification errors. The soft tissue cleft gap at the lip level was reduced by 9.3mm on the right and 7.9mm on the left. At the alveolar level, there was a 6.7mm reduction in cleft defect achieved on the right and a 4.5mm reduction on the left. The total nostril width was reduced by 10mm, the nostril height increased by 3.6mm and the severely deficient columella was increased to 3.1mm.



**Figure 6:** Intraoral photographs showing treatment progress. (A - pre-treatment intraoral photograph before insertion of aligner 0; B - after insertion of aligner 1; C - after insertion of aligner 3; D - after insertion of aligner 5; E - after insertion of aligner 7; F - after insertion of aligner 9; G - post-treatment intraoral photograph after aligner 11)



**Figure 7:** Post treatment extraoral and intraoral photographs

**Table 1. Pretreatment and posttreatment linear measurements**

Parameters (mm)			Pre treatment	Post treatment
<b>Soft tissue cleft gap</b>	Lip level	Right	15.4	6.1
		Left	13.2	5.3
	Alveolar level	Right	8.0	1.3
		Left	5.9	1.4
<b>Total nostril width</b>			41.0	31.0
<b>Nostril height</b>			2.0	5.6
<b>Columella length</b>			Severely deficient	3.1

## Discussion

Presurgical infant orthopedics creates the foundation for good treatment outcome of primary lip and nasal surgery. This case shows a good treatment outcome of presurgical infant orthopedics which was achieved with NAM aligners along with nasal hooks. The success may be attributed to three factors, namely; proper patient selection – a day old infant,<sup>3,4</sup> comfort of the NAM aligners<sup>12</sup> and caregivers' comfort.<sup>12</sup>

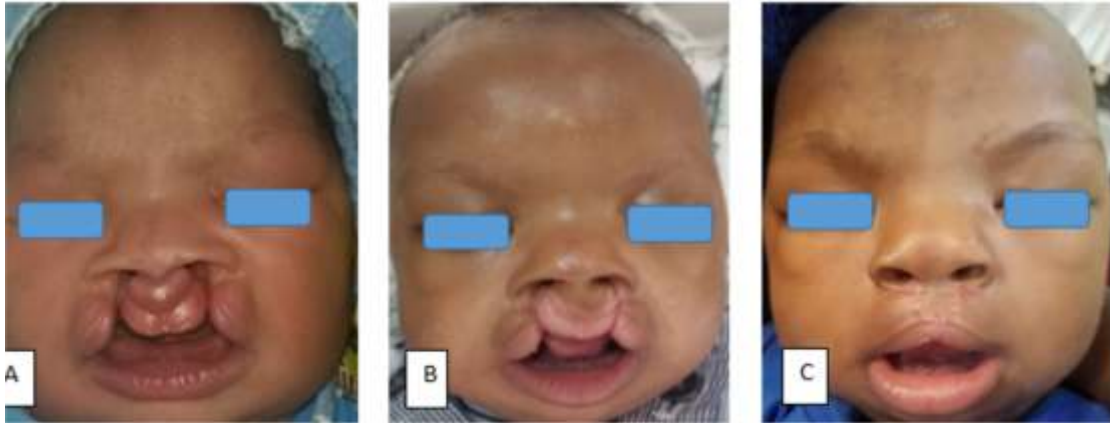
Matsuo<sup>3,4</sup> recorded that presurgical infant orthopedics is more effective when commenced early, immediately after birth. It was suggested that the high level of estrogen during childbirth with the increased levels of hyaluronic acid, prevents intercellular cartilage matrix linkage makes the facial cartilages soft and lacking elasticity allowing for the molding.<sup>3,4</sup> The infant in this present case presented few hours after birth, this can be attributed to the successful treatment outcome.

The use of NAM aligners also simplifies the molding process eliminating the laboratory procedures in the Grayson technique thus making the process more convenient for the patient and the caregiver by eliminating multiple visits. In addition, the unwanted effects<sup>12</sup> associated with acrylic plate—such as pressure ulcers and soft tissues laceration are eliminated, in addition to the light weight of the

aligners may have contributed to increased tolerance of the appliance by the infant.<sup>12</sup>

Taking into consideration that the NAM aligners are removable appliances, compliance of the caregivers in the use of the aligners as well as the nasal stents and lip taping could also have contributed to the treatment outcome. Nasal moulding was commenced after six weeks of aligners therapy with the NAM aligners according to the principles of Grayson and Maull,<sup>13</sup> which states that with alveolar gap reduction, there is improvement of alignment of the base of the nose and the adjacent lip segment. This leads to laxity of the previously tense alar rim and allow for the nasal molding to take place more efficiently.

After 12 weeks of presurgical infant orthopaedic treatment using NAM aligners, nasal hooks and lip taping; the size of the cleft defect was significantly reduced, the nasolabial aesthetics was improved, and alignment and approximation of the intraoral alveolar cleft segments were achieved as well as significant increase in the columella length (Figure 7). This is in agreement with most authors who reported that PSIO with NAM results in alignment and approximation of tissues, improved nasolabial aesthetics, increase in columella length, significantly better surgical outcome compared with patients who do not undergo NAM therapy.<sup>1,5</sup>



**Figure 8:** Extraoral photographs A: before PSIO, B: after PSIO, C: post-surgery.

## Conclusion

This case has demonstrated the successful treatment of a case of bilateral cleft of the lip, palate and alveolus with presurgical infant orthopaedics using clear aligners.

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West African Journal of Orthodontics is a peer-reviewed journal published by affiliated Orthodontic Groups and Associations in the West African Sub region. The journal gives priority to reports of outstanding clinical and experimental and epidemiological works on malocclusion, dento-facial defects as well as important contributions related to common orthodontic problems in children, adolescents and adults worldwide.

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Manuscripts and registered letters should be sent to: the Editor, West African Journal of Orthodontics, Department of Child Dental Health, Faculty of Dentistry, College of Health Sciences Obafemi Awolowo University, Ile-Ife, Osun State. Nigeria.

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However, photographs and/or figures need to be sent separately as hard copy (under figures and illustrations).

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- Use at least 12 point font size (Times New Roman or Arial).
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Competing interest for a given manuscript exists when the author has ties to activities that could inappropriately influence his or her judgment, whether or not judgment is in fact affected. Financial relationships with industry for example, through employment, consultancies, stock ownership, honoraria, expert testimony, either directly or through immediate family, are usually considered to be the most important competing interests. However, conflicts can

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Acknowledgment section may be included where necessary. Number of tables and figures should be limited to the very relevant ones and may be compressed if necessary. The typical text length for such contributions is 2500-3 500 words (excluding title page, abstract, tables, figures, acknowledgments and references).

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Abstract should be of 100-150 words highlighting the aims, methods and main results along with 3-4 key words.

The text should contain no more than 1500 words, 3 illustrations or tables and up to 20 references, preferably recent publications.

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Letters commenting upon a recent article in the West African Journal of Orthodontics are welcome.

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Normally only clinical photographs are accepted but accompanying skiagrams or pathological images could also be considered for publication.

Photographs should be of high quality, clearly identify the condition and preferably add to the existing knowledge.

## **Personal Viewpoint**

Such articles are published on topical orthodontic issues including social aspects. It is expected that the authors have sufficient credible experience on the subject for giving viewpoints. These should not exceed 1500 words.

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Authors should provide complete details of any new methods or apparatus used (manufacturer's name and address in parentheses).

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## Acknowledgements

In acknowledgements section, it is suitable to list all contributors who do not meet the criteria for authorship, such as a person who provided purely technical help, writing assistance, or a department head who provided only general support. Financial and material support should also be acknowledged.

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## Appendix 1:

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