Research Article

Early Orthodontic Intervention Prior To Surgery In An Infant With Complete Unilateral Clp

Murad Hamood Mohammed Qassim

First Moscow State Medical University I.M. Sechenov (Sechenov University) dr.murad@dr-muradortho.com

Abstract

This study aimed to evaluate the effectiveness of using fixed, intraosseous fixed appliances in early orthodontic treatment for children with unilateral cleft lip and palate, compared to removable appliances. The study included two groups of children: the first (n = 31) received treatment with fixed intraosseous appliances, while the second (n = 25) received conventional treatment with removable appliances. Treatment outcomes were analyzed in terms of treatment duration, surgical timing, and functional and cosmetic improvement of the face and jaws. The results demonstrated a clear superiority for the fixed appliance group, with approximately a 24-fold reduction in preparation time for initial surgery, in addition to improved timing and quality of cosmetic procedures. These results are attributed to the superior ability of fixed appliances to direct consistent and precise forces on the maxillary fragments, contributing to improved bone remodeling during the critical biogenesis period. The study concluded that early orthodontic treatment using fixed appliances is an effective option in improving the therapeutic and cosmetic outcomes of children with unilateral cleft lip and palate and is recommended as part of standardized treatment protocols in the early stages of development.

Keywords: Orthodontic Treatment, Unilateral Cleft, Fixed Intraosseous, Removable Appliances, Maxillary Fragments.

1. Introduction

Cleft lip and palate (CLP) are one of the most common craniofacial abnormalities today (Sader, 2009; Tian et al., 2017). It is estimated that one in every 500 to 700 births worldwide is affected by this malformation (Bühling et al., 2025). Despite the widespread prevalence of this disorder, there is still no global consensus on treatment protocols, as the timing and number of surgeries required to repair cleft palates vary from case to case (Suri et al., 2012).

These abnormalities, which involve multiple soft tissue and bony structures within the oral cavity, result from a disruption in the formation of the upper lip and palate, which typically occurs between the sixth and twelfth week of fetal development. This disorder results in the failure of the normal fusion of the maxilla and the medial nasal prominences, followed by the failure of the primary palate to fuse with the lateral palatal ridges (Sperber & Sperber, 2012). These cleft defects can have profound, multi-level negative consequences for both the affected individual and their family, due to the potential problems they cause in proper nutrition, physical growth, hearing, and speech development, in addition to the aesthetic and psychosocial impacts resulting from the deformity of the condition (Berkowitz, 2006).

These deformities affect the skeletal structures and soft tissues of the lips, nose, and facial bones, resulting in a disruption of the aesthetic harmony of the face. The lack of consensus on the best treatment strategy for children born with cleft lip and palate remains a significant challenge, with significant differences in treatment protocols and surgical interventions adopted by centers treating these conditions. The inclusion of preoperative orthodontic treatment is among the most controversial aspects of these individual protocols (Shaw et al., 2005; Kornbluth et al., 2018).

The idea of single-stage cleft closure has been promoted with the aim of reducing the number of surgical interventions that affected children undergo (Sader et al., 2009). Based on this therapeutic approach, surgical closure of the lip, alveolar bone, and soft palate is performed in a single procedure, typically around six months of age, to restore anatomical structures early in the child's life and help mimic normal maxillary growth (Liao et al., 2006). This standardized surgical procedure also supports normal speech development and reduces the psychological impact of multiple operations (Brand et al., 2009). Furthermore, performing surgery during the first year of life promotes healing with minimal scarring, given the child's partial capacity for healing at this stage, like that associated with the fetal stage (Bühling et al., 2025).

The use of preoperative orthodontic treatment in children (PSIO) has been proposed as an effective tool for improving the short-term management of cleft lip and/or palate by supporting feeding, reducing developmental delays, and normalizing swallowing function (Gnoinski, 1990). The improvements achieved by this intervention in the shape of the dental arch and nasal deformities also facilitate subsequent surgical procedures by reducing tension in the surgical area. In the long term, this therapeutic approach is credited with promoting speech development, improving maxillofacial growth, and enhancing facial aesthetics, thus reducing the need for additional specialized interventions in the future (Prahl et al., 2001). Preoperative intraosseous orthopedic surgery (PSIO) is the term used to describe any intervention aimed at treating the alveolar structures in infants prior to lip and nasal repair. Although there is no global consensus on the goals of this type of treatment, they generally include improving the alignment of the infant's alveolar structures, facilitating initial lip and nasal repair, and achieving improved cosmetic outcomes without adversely affecting facial growth.

This study will focus on fixed and removable appliances as a therapeutic orthodontic intervention for children with unilateral cleft lip and palate. Some studies have shown that fixed appliances achieve faster and more accurate results in reducing cleft width and subsequent surgeries, but few studies have compared their effectiveness to that of removable or removable appliances.

Based on the above, this study aims to compare the outcomes of using fixed intraosseous appliances versus removable appliances in early orthodontic treatment for children with unilateral cleft lip and palate, and to evaluate the differences between the two groups in terms of treatment duration, timing of surgery, and anatomical improvement.

2. Method

2.1. Study Design and Setting

This retrospective observational study was conducted between 2005 and 2010 at the Department of Oral and Maxillofacial Surgery, Moscow Regional Institute, a specialized center for cleft lip and palate treatment. The study aimed to evaluate the effectiveness of early orthodontic intervention in infants diagnosed with unilateral complete cleft lip and palate (UCLP) prior to their first surgical procedure.

Orthodontic treatment was provided as part of a multidisciplinary rehabilitation protocol involving pediatric dentists, maxillofacial surgeons, pediatricians, and radiology specialists.

2.2. Participants in the Study

This study was conducted on 84 infants, who were examined during their first visit to the Center for Orthodontics and Cleft Lip and Palate Surgery. The children's ages ranged from 7 days to 1 year, and all were diagnosed with varying degrees of unilateral or bilateral cleft lip and palate. The infants were categorized based on the type of cleft as follows:

- 14% :Unilateral cleft lip only (UCL).
- 29% :Unilateral cleft involving the lip and alveolar process (ORGAO).
- 57%: Unilateral cleft involving the lip, alveolar process, and palate (OPG).

Exclusion Criteria and Clinical Considerations:

- Infants diagnosed with acute respiratory viral infections (ARVI) were excluded from receiving presurgical orthodontic treatment.
- 100% of infants with ORGAO required presurgical orthodontic treatment.
- Assessment of bone tissue density revealed a non-linear correlation between the child’s age and bone elasticity, indicating that bone flexibility is age-dependent

Group Classification

84 children with unilateral cleft lip, bilateral cleft lip, and unilateral complete cleft lip and cleft were examined. All children examined were distributed by sex and type of cleft, and these data are presented in the table below, Table 1.

Table 1. Distribution of patients by type of cleft and gender

Type of Pathology	Males	Females	Total Patients
OPT	33	25	58
OPTAO	11	7	18
OPG	5	3	8
Total	53	31	84

According to the data in the table, the number of males born with a unilateral cleft exceeds that of females by 1.3 times. This data is consistent with previous studies. Overall, patients with a complete unilateral cleft lip and palate constitute 58% of the total number of patients with unilateral cleft lip and palate and unilateral alveolar malalignment. This data was included in the table as one of the criteria for selecting patients for screening.

Another equally important factor for this study was the complexity of the alveolar ridge deformity and the 100% need for orthodontic treatment prior to primary rhinoplasty. As a result, 56 children with complete cleft lip and palate were selected for screening.

After clinical examination and diagnosis, preoperative orthodontic treatment was provided to all patients with parental consent. Two treatment methods were used: removable orthodontic appliances and fixed orthodontic appliances.

The 56 children from the total sample were classified into two main groups:

I. **Group 1 (25 children):** All of them had ORGAO and received orthodontic treatment using removable appliances.
II. **Group 2 (31 children):** They were initially planned to receive orthodontic treatment with fixed appliances, but due to their young age (less than 4 months), treatment with removable appliances was initiated to improve breastfeeding in the initial phase. The group of 31 children (group 2) was divided into three subgroups, based on treatment progression and clinical modeling results, Table 2, 3, 4:

Table 2. Subclassification of Group 2

Subgroup	Number of Patients	Description
Subgroup A	7	Did not require fixed appliances in the final stage
Subgroup B	21	Required fixed appliances at the final stage
Subgroup C	3	Treated directly with fixed appliances

Table 3. Age-based Distribution of Subgroups within Group 2

Age Range	Subgroup A	Subgroup B	Subgroup C
0–1 month	8	6	-
1–3 months	-	9	-
3–6 months	-	4	2
6–12 months	-	-	2
Total	**8**	**19**	**4**

Table 4. Age Indicators for Subgroups in Group 2

Age Indicator	Subgroup A (8 pts)	Subgroup B (19 pts)	Subgroup C (4 pts)
Mean Age (in days)	13.4	35	204.75
Age Range	6–30	5–89	151–270

The data in the tables above show that the younger the patient, the more likely they are to be prepared for the first stage of surgical treatment without the use of fixed orthodontic appliances. Conversely, the older the patient, the greater the need for treatment with fixed orthodontic appliances with intraosseous anchorage.

2.3. Intervention Protocols

The study relied on the application of two main pre-surgical orthodontic treatment protocols. Children were assigned to these two protocols based on their age, degree of deformity, and parents' response to treatment. The first method involved the use of removable orthodontic appliances, while the second included fixed orthodontic appliances. Each was applied according to each child's clinical condition, based on precise diagnostic indicators.

Regarding the first protocol, removable orthodontic appliances were used on children in the first group (n = 25), as well as all children in the second group during the first four months of life. This phase of treatment aims to redirect jaw growth early in life, reduce the gap between the alveolar bone fragments, and improve breastfeeding, which is often affected in cases of oral clefts. These appliances also contribute to achieving functional and morphological balance in the nasal structure, which is of utmost importance before undergoing cosmetic surgical interventions.

The removable appliance is designed to include an acrylic plate that completely covers the palate, along with a nasal stent, often used in cases of concomitant oral and nasal deformities. It also includes 0.8 mm stainless steel wires to ensure stability in the mouth. Metal elements are attached to the back of the upper jaw, and nasal guides are sometimes added in cases requiring support for reshaping the nasal base.

These appliances are manufactured based on a preliminary impression of the child's upper palate taken during the first days of life. The appliance is then fabricated in the laboratory within 24–48 hours and delivered to the parents with a detailed explanation of how to use and clean it. It is recommended that the appliance be worn continuously throughout the day, removed only for oral hygiene or for cleaning the appliance itself. The child is periodically re-evaluated every one to two weeks to make necessary adjustments based on bony changes.

The second protocol involves the use of fixed orthodontic appliances, which is the protocol adopted for children in the second group (n = 31) after they have completed the first phase of removable treatment. This type of appliance represents the most precise and effective treatment option in cases of advanced maxillary deformity and extensive separation between the alveolar fragments. These appliances aim to stabilize the results achieved during the initial phase and support more controlled repositioning of the bone fragments, improving subsequent plastic surgery outcomes, and reducing the need for additional surgeries in the future.

The fixed appliances are made of acrylic plates that are fixed directly to the upper jaw, with small screws that allow the doctor to control the spacing between the fragments through gradual expansion. Metal supports are also added to help guide the growth of the upper nose in the appropriate direction. These appliances are fixed inside the mouth using dental or intraosseous anchors, depending on the child's age and the extent of their skeletal development. Periodic adjustments are made every one to two weeks to ensure an optimal response to treatment.

Treatment results are carefully evaluated using oral imaging and 3D analysis of plaster cast models, in addition to monitoring improvements in breastfeeding, weight gain, and the ability to breathe both orally and nasally. Clinical studies have shown that the effectiveness of removable appliances is directly proportional to the earliest treatment initiation after birth. The older the child, the greater the likelihood of requiring fixed appliances due to the complexity of the deformity and the degree of bone stiffness.

The success of either protocol depends on several key factors, most notably the degree of alveolar deformity, the child's age at the start of treatment, their place of residence, and the parents' cooperation and willingness to provide ongoing follow-up. The child's general health is also an important criterion in selecting the type of appliance and determining the duration of treatment. In cases where fixed appliances are used, it is also important to analyze the results at each stage to adjust the pace of treatment progress, especially in complex types of clefts such as Types II and III, where the bony gap is very wide and may reach more than 20 mm, requiring advanced remodeling of the nasal maxillary structure.

2.4. Evaluation Methods

A combination of clinical, laboratory, and standard evaluation methods was used to assess the effectiveness of preoperative orthodontic intervention for children with unilateral cleft lip and palate. The evaluation methods were distributed across the different treatment phases, from the initial examination to the post-application of orthodontic appliances.

First, all children included in the study underwent a comprehensive clinical examination at their first visit. This examination included determining the type of cleft (UCL, ORGAO, OPG), its location (right or left), the degree of alveolar fragment separation, and the severity of nasal base deformity. Age at the first visit was also accurately recorded, from the first days after birth to 12 months of age, a key factor in selecting the appropriate intervention protocol.

After initial classification, plaster casts of the upper palate were taken using flexible medical materials designed for newborns. Accurate anthropometric measurements were performed on these models, including the distance between the alveolar fragments, the width of the alveolar arch, and the degree of maxillary expansion. For comparative evaluation purposes, these models were documented in the form of three-dimensional digital images before and after treatment.

Bone tissue density was also measured using laboratory indicators to determine bone elasticity. The analysis results revealed a nonlinear relationship between bone elasticity and patient age. Accordingly, the infants were divided into precise age groups (0–1 month, 1–3 months, 3–6 months, and 6–12 months).

Additional assessment tools were used to monitor functional performance during breastfeeding, including monitoring the infant's weight, sucking pattern, and vomiting rate. Monthly evaluations were conducted to monitor bone development and the effectiveness of the device in reducing the intersegmental distance, using standardized measuring tools.

In addition, parental cooperation and adherence to the treatment protocol were documented, as this factor played an important role in explaining differences between outcomes in anatomically similar cases. Multiple medical reviews were conducted by a multidisciplinary team (oral and maxillofacial surgeon, orthodontist, and pediatrician) to ensure the objectivity of the assessment.

2.5. Outcome Measures

Several quantitative and qualitative measures were adopted to measure the effectiveness of pre-operative orthodontic treatment. These measures were divided into three main categories: anatomical indicators, functional indicators, and organizational and behavioral indicators.

1 .Anatomical indicators:

The most important outcomes of this dimension included measuring the change in the inter-alveolar distance before and after treatment and assessing the remodeling of the alveolar arch and the shape of the nasal base. Comparisons were made between plaster models and digital photographs taken pre- and post-treatment, with mean differences calculated according to specific age groups. The most prominent anatomical indicators adopted were:

- Reduced inter-alveolar distance (in millimeters).
- Improved nasal symmetry (symmetry index).
- Adjusted orientation of the small jaw relative to the large jaw.

The results showed that children who began treatment early (before one month of age) were able to achieve up to 80% better intermaxillary convergence compared to those who began treatment at a later age.

2 .Functional Indicators:

This category included measurements of improved breastfeeding, the child's ability to suck, weight gain, and reduced choking during feeding. It was observed that children who used removable orthodontic appliances early showed significant improvements in feeding patterns and experienced fewer breathing problems during feeding.

3 .Behavioral and Organizational Indicators:
These indicators included assessing the extent to which parents adhered to device usage instructions (duration of use, cleaning, and attendance at appointments), in addition to evaluating cooperation between the medical team and the family. It was found that the success of treatment depends fundamentally on family support and regular follow-up, especially in cases of fixed appliances.
In addition to these indicators, the results of the second group were divided into three subgroups according to their response to treatment. This constituted an independent indicator of treatment effectiveness relative to age and the need for permanent appliances at the end of the treatment period.
Finally, statistical analyses were used to assess differences between groups, and statistical significance tests were conducted to determine the accuracy of the results obtained.

3. Results

The results of clinical analysis, laboratory measurements, and long-term follow-up showed significant differences in the effectiveness of preoperative orthodontic treatment for children with unilateral cleft lip and palate. These differences were monitored by carefully monitoring the effect of orthodontic appliance type, age at initiation of intervention, and severity of anatomical deformity. These results were reflected across a range of clinical, functional, and economic indicators.

3.1. Overall Response to Treatment in the Two Groups
The study included two main groups:
The first group (n=25) received orthodontic treatment using removable appliances only, while the second group (n=31) included children who received initial treatment with removable appliances, some of whom were later converted to fixed appliances based on their degree of response.
The results showed that improvements in alveolar fragment convergence, nasal base alignment, and anatomical/functional balance were significantly higher in children in the second group, especially in cases classified as Type III deformities.
Although children who started treatment early (less than one month of age) in both groups achieved good results, the effectiveness of fixed appliances was more stable in the complex cases included in the second group. This group demonstrated faster and more consistent improvement in maxillary anatomical shape and early readiness for surgery.

3.2. Effect of Age at Start of Treatment
Age was found to be a decisive factor in alveolar bone response to treatment. Children who started orthodontic intervention in the first weeks of life (0–1 month) had the highest scores for fragment convergence and improved palatal arch alignment. In this group, treatment with removable appliances alone was sufficient to achieve acceptable results.
In contrast, children who started treatment after 3 months of age had a poorer response, and most required transitioning to fixed appliances to correct arch and bone deformities.

3.3. Analysis of Outcomes by Cleft Anatomical Type
Cases were classified into two main types based on the severity of the alveolar separation:
Type II: With spacings ranging from 9–18 mm, this group demonstrated good response, particularly with early treatment using removable appliances. This group achieved satisfactory functional and anatomical results without the need for further intervention.
Type III: With larger spacings (16–22 mm) and significant mandibular deformities, a combination of removable appliances in the early stages and fixed appliances later was often required to achieve adequate functional and structural convergence preoperatively.

3.4. Evaluation of Outcomes by Appliance Type
Removable appliances demonstrated significant effectiveness in reducing the alveolar separation in younger children, with the mean diastasis decreasing from 16.8 mm to 8.4 mm after a 16-week treatment period. However, this effectiveness was contingent on family cooperation and careful adherence to treatment instructions.
The average duration of treatment with removable appliances was 234 days, with the need for frequent appliance adjustments, and the total cost amounted to 81,138 Russian rubles. Furthermore, some cases remained susceptible to secondary bone grafting due to limited convergence in complex cases.

In contrast, fixed appliances, particularly those implanted on alveolar bone, demonstrated faster and more stable results. In some cases (such as patient C), rapid jaw convergence was achieved within just 10 days after fixed treatment, with the diastema degeneration decreasing from 8.4 mm to 4 mm, achieving near-normal alignment of the maxillary arch, Figure 1. Furthermore, in later cases (such as patient K), fixed treatment resulted in a significant reduction in diastema from 14 mm to acceptable functional values in just 12 days, Figure 2.
The duration of treatment with fixed appliances was significantly shorter (10–14 days) and cost 39,125 Russian rubles, 2.07 times less than removable treatment.

3.5. Clinical and Functional Indicators

Functional indicators showed improvements in feeding, breathing, and physical growth, because of corrected diastasis and improved nasal base support. Rates of vomiting and nocturnal choking also decreased. Suckling and feeding improved, which positively impacted weight gain. These indicators were more evident in children who received stable and rapid orthognathic treatment using fixed appliances.

3.6. Comparison Between the Two Groups

In general, removable appliances were suitable and effective for children under one month of age, provided family cooperation and regular follow-up. However, in late-stage cases or complex type III clefts, fixed appliances were necessary to achieve adequate anatomical results and surgical readiness.
The results showed that children in the second group completed treatment with fewer adjustment sessions, faster functional improvement, and a higher rate of surgical readiness. They also achieved higher jaw alignment according to plaster measurements. The results also showed that the fixed device resulted in a direct cost reduction of approximately 42,000 Russian rubles per patient, and a 60% improvement in indirect economic efficiency due to a reduction in the number of subsequent interventions and a reduced need for bone grafting or secondary surgeries, Table 5.
The comparative analysis also showed that the average treatment duration in the first group was 7.8 months (234 days), compared to only 9.5 days in the second group, a 24.6-fold reduction. The indications for the use of fixed appliances in the later stages also increased to 75%. The study results showed that the use of non-removable appliances with intraosseous fixation improves clinical efficacy, reduces treatment duration, and allows for accurate planning of the timing of primary cheiloplasty with rhinoplasty.
Early planning of orthodontic treatment allowed for the subsequent rehabilitation stages to be organized. According to a subsequent questionnaire, the average age of the children was 3 years and 4 months. The disability rate in the first group was 100%, and in the second group was 61.29%. Primary cheiloplasty was performed at 8 months and 14 days in the first group, and at 5 months and 5 days in the second group. Staged rhinoplasty was performed in both groups at 100%.
Parents rated the results as "good" in 89% of cases, "satisfactory" in 10%, and "unsatisfactory" in 1%. 61% of parents believed that the surgical outcome depended on orthodontic treatment. Palatoplasty was performed at 16 months and 3 days in the first group, and at 11 months and 27 days in the second. Children began speaking at 2.5 years in the first group, while in the second group, it was only 6 days after surgery. Speech therapy was indicated in 100% of the first group and 78% of the second group. Rhinolalia was diagnosed in only 5 children in the second group. 12% of parents in the first group indicated that their children had been rehabilitated, compared to 38% in the second group. Finally, a comparison group of adults who did not undergo early treatment was analyzed. Maxillary growth abnormalities were observed in 95% of cases, persistent nasal abnormalities in 100%, an oronasal opening in 35%, palate abnormalities in 20%, a reduced oral vestibule in 90%, and excess scar tissue in 75%. Respiratory disorders were also present in 80%, speech disorders in 95%, and lip and tongue muscle dysfunction in 100%. All children were classified as having a disability since infancy.

Table 5. Summary Table of Results

Group	Patients	Appliance Type	Total Treatment Duration	Diastasis Reduction	Cost (RUB)	Need for Bone Graft
Group 1	25	Removable	~234 days	16.8 → 8.4 mm	81,138	High

Group 2	31	Fixed (some after Removable)	7–21 days	14–16.8 → ~4 mm	39,125	Low

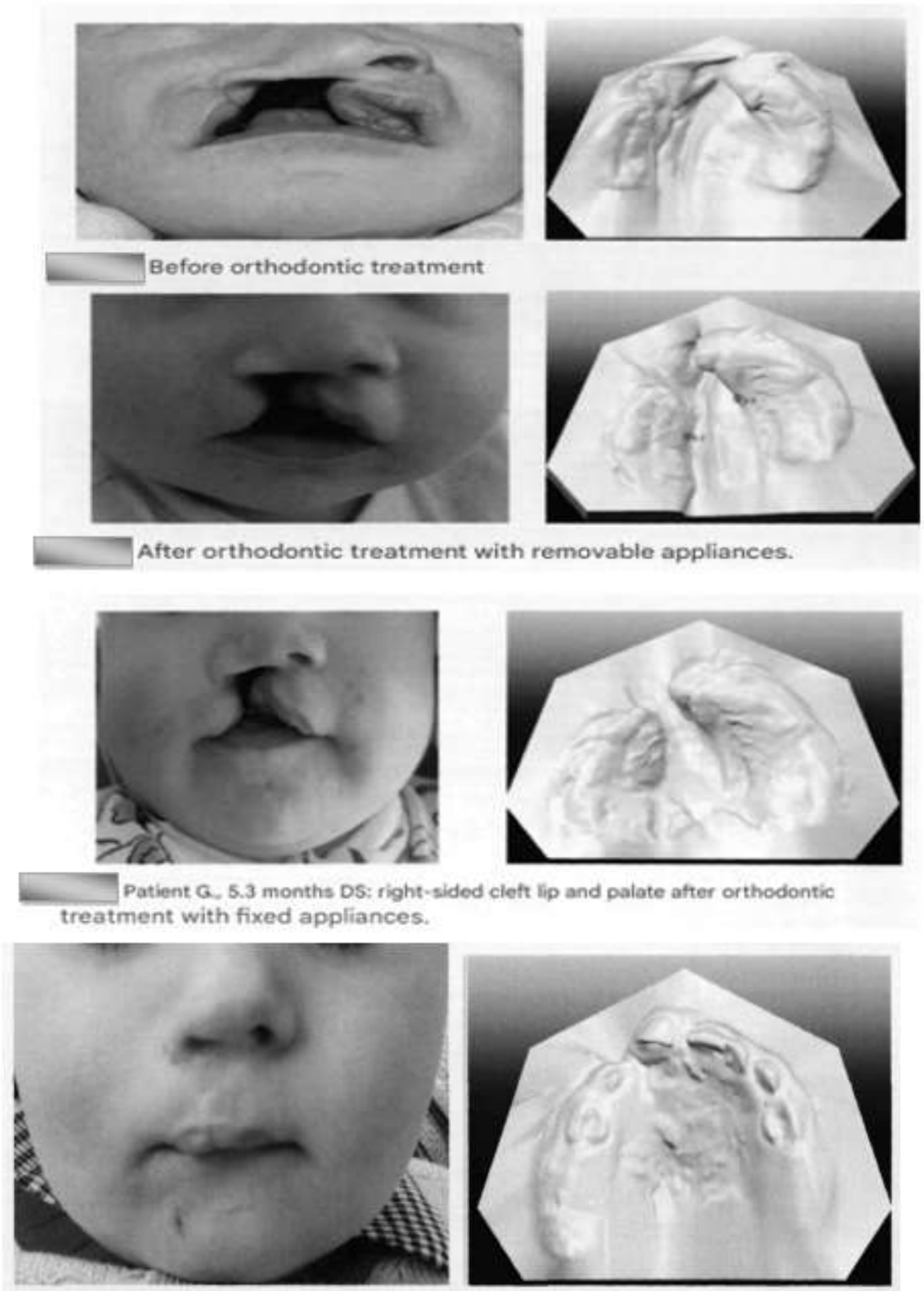

Fig. 1 Patient G., 5.3 months DS: right-sided cleft lip and palate after orthodontic treatment with fixed appliances.

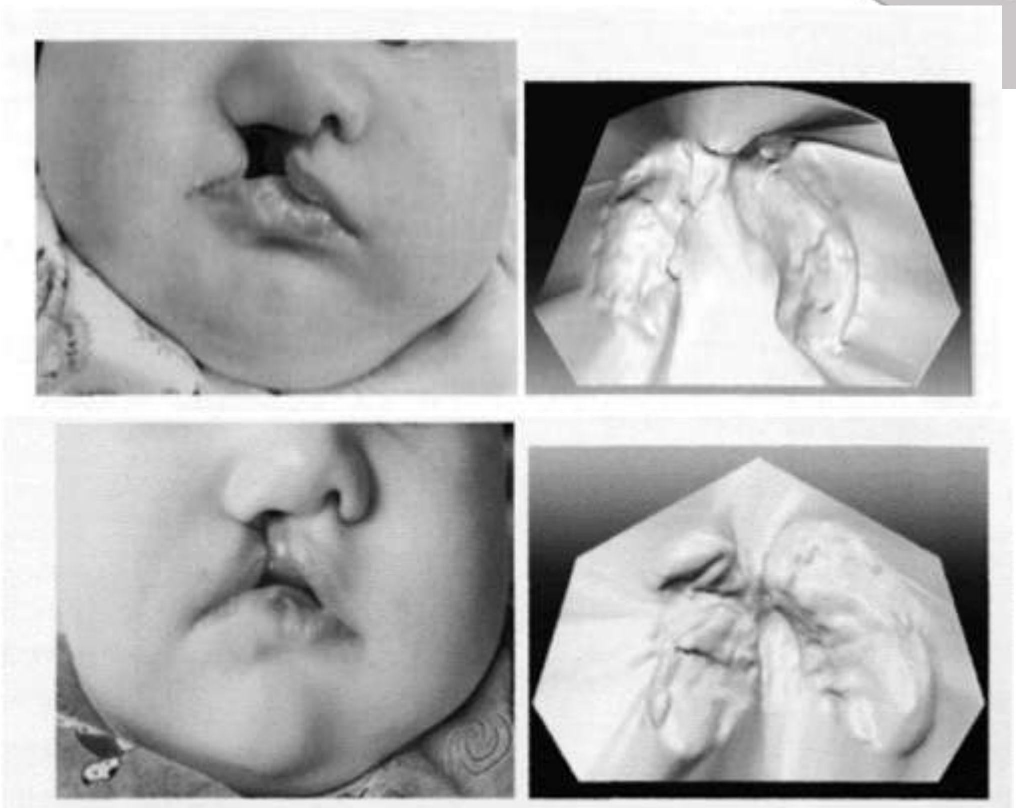

Fig 2. A: Patient K. DS: right-sided cleft lip and palate before orthodontic treatment, B. Patient K. DS: right-sided cleft lip and palate after orthodontic treatment

4. Discussion

The primary goal of treating children with unilateral cleft lip and palate is to restore the anatomical, functional, and physiological integrity of the maxillofacial structure. Despite extensive experience among local and international schools in implementing early orthodontic treatment prior to primary lip and rhinoplasty, the necessity of this intervention and the selection of the appropriate treatment method remain controversial among some specialists.

The introduction of orthodontic treatment using fixed intraosseous appliances was a response to an urgent need to perform primary surgery in conjunction with rhinoplasty in a single, more qualitative manner, in line with modern trends in early rehabilitation for children with cleft lip and palate (Millard et al., 1999; Berkowitz, 2006). Hagerty et al., 1964, was the first to publish a study on the use of a fixed appliance to treat bilateral cleft lip and palate. In 1968, Latham (1980) developed improved appliances for the treatment of bilateral and unilateral clefts. These were later developed by Millard et al. (1999). This method is used in numerous medical centers in Europe and America.

In this study, a pilot phase was conducted in the laboratory to determine the medical and technical requirements for the treatment method, fixation, and selection of active agents for the transfer of maxillary fragments. The study included an analysis of clinical problems facing treatment with fixed appliances, such as the optimal age for appliance placement, appliance imbalance resulting from facial bone strength, and the nature of the force applied to move the fragments.

Comparative results between the two groups indicate a clear superiority of early orthodontic treatment using fixed appliances with intraosseous fixation over traditional treatment with removable appliances, in terms of effectiveness and speed of achieving therapeutic goals before initial surgery. Children who received fixed treatment showed a significant reduction in treatment time, approximately 24 times faster than those who used removable appliances, with a significant improvement in the timing of primary rhinoplasty. This was confirmed by a study (Yin et al., 2022), which showed that early orthodontic treatment significantly improves surgical outcomes in cases of unilateral clefts.

These differences in outcomes are largely attributed to the biomechanical ability of fixed appliances to transmit continuous and controlled forces to the maxillary fragments, allowing for redirection of bone growth and development during a critical period of tissue formation. In contrast, removable appliances suffer from limited force control and are affected by parental non-compliance, leading to a slower treatment response and variability in outcomes. A study (Winnand et al., 2024) also demonstrated that using finite element modeling (FEM), active appliances generate precise mechanical patterns that contribute to a more controlled reorganization of the bone fragments.

These findings are supported by several previous studies that have emphasized the importance of early orthodontic intervention in cases of cleft lip and palate (Vig & Mercado, 2015; Sahoo et al., 2023). This was confirmed by a recent systematic review (Bühling et al., 2025), which indicated the effectiveness of preoperative 3D orthodontics. Active orthodontics was more accurate in controlling the bony cleft and improving nasal and maxillofacial symmetry. This study also demonstrated that fixed treatment was effective in paving the way for earlier and more precise plastic surgery, contributing to improved functional and cosmetic outcomes and reducing long-term motor and speech impairment. This finding is consistent with the findings of a recent meta-analysis (Benitez et al., 2024) comparing the use of passive and active orthodontics in European centers, where improvements were greater in the group receiving active treatment. When comparing the outcomes of children who received early treatment with the group of adults who did not receive orthopedic intervention in early childhood, clear differences were found in favor of the former group. More severe structural and functional abnormalities were seen in the control group, including permanent nasal deformities, incomplete nasal-oral connections, and speech and breathing disorders in most cases. This reinforces the hypothesis that the absence of early intervention leads to unsatisfactory long-term treatment outcomes.

Although the study showed encouraging positive results, there are some limitations that must be considered, such as the different timing of surgical procedures, social factors that may affect follow-up, and the small sample size in some subgroups. Therefore, future multicenter studies using standardized treatment and surgical protocols are recommended to further verify the effectiveness of the adopted treatment model.

Accordingly, the introduction of fixed bone-fixation appliances as a first-line treatment option for unilateral cleft lip and palate in early childhood represents a qualitative shift in treatment outcomes and enhances the opportunities for functional and developmental rehabilitation for these children in a sustainable manner (Lalwani et al., 2025).

5. Conclusion

The results of this study demonstrated that early orthodontic treatment using fixed, intraosseous anchored appliances is significantly superior to removable appliances in preparing children with unilateral cleft lip and palate for initial surgery. This type of intervention significantly reduced treatment time improved the quality and timing of surgical procedures and achieved better cosmetic and functional outcomes. This improved approach to orthodontic treatment for children with unilateral cleft lip and palate enhances the effectiveness of complex treatment, reduces the duration of disability, and lowers the economic costs of treatment and rehabilitation.

A comparative analysis of treatment effectiveness showed that the use of non-removable appliances with an active component made of shape memory metal reduced treatment time by 24 times. This superiority is attributed to the biomechanical capabilities of fixed appliances to direct continuous and precise forces, which aids in bone remodeling during the critical growth phase. In contrast, removable appliances suffer from limitations related to force control and the impact of family commitment on treatment effectiveness.

These results underscore the importance of including fixed appliances in early treatment protocols for children with these conditions, given their positive impact on reducing the incidence of secondary deformities and speech and breathing disorders in the future. The study recommends future multicenter studies using standardized protocols to support and enhance these findings and disseminate them clinically on a wider scale.

References

1. Benitez, B. K., Brudnicki, A., Tache, A., Wieprzowski, Ł., Surowiec, Z., Nalabothu, P., ... & Mueller, A. A. (2024). Comparative study on cleft palate morphology after passive presurgical plate therapy in unilateral cleft lip and palate. Journal of Plastic, Reconstructive & Aesthetic Surgery, 92, 198-206.

2. Berkowitz, S. (Ed.). (2006). Cleft lip and palate. Berlin, Heidelberg: Springer Berlin Heidelberg.
3. Bühling, S., Selge, H. M., Eslami, S., Seifert, L. B., Sayahpour, B., Plein, N., ... & Kopp, S. (2025). Impact of Active and Passive Maxillary Plates on Cleft Width Morphology in Unilateral Cleft Lip and Palate: A Prospective Intervention Study. Children, 12(6), 714.
4. Gnoinski, W. M. (1990). Infant orthopedics and later orthodontic monitoring for unilateral cleft lip and palate patients in Zurich. Multidisciplinary management of cleft lip and palate. Philadelphia: WB Saunders, 578-585.
5. Hagerty, R. F., Andrews, E. B., Hill, M. J., Calcote, C. E., Karesh, S. H., Lifschiz, J. M., & Swindler, D. R. (1964). Dental arch collapse in cleft palate. The Angle Orthodontist, 34(1), 25-36.
6. Kornbluth, M., Campbell, R. E., Daskalogiannakis, J., Ross, E. J., Glick, P. H., Russell, K. A., ... & Sitzman, T. J. (2018). Active presurgical infant orthopedics for unilateral cleft lip and palate: intercenter outcome comparison of Latham, modified McNeil, and nasoalveolar molding. The Cleft Palate-Craniofacial Journal, 55(5), 639-648.
7. Lalwani, Y. M., Dave, B. H., & Shah, C. H. (2025). Advancements and Efficacy of Presurgical Infant Orthopedics in Cleft Lip and Palate Treatment: A Comprehensive Review. Journal of Integrated Health Sciences, 13(1), 17-21.
8. Latham, R. A. (1980). Orthopedic advancement of the cleft maxillary segment: a preliminary report. The Cleft palate journal, 17(3), 227-233.
9. Liao, Y. F., Cole, T. J., & Mars, M. (2006). Hard palate repair timing and facial growth in unilateral cleft lip and palate: a longitudinal study. The Cleft palate-craniofacial journal, 43(5), 547-556.
10. Millard, R. D., Latham, R., Huifen, X., Spiro, S., & Morovic, C. (1999). Cleft lip and palate treated by presurgical orthopedics, gingivoperiosteoplasty, and lip adhesion (POPLA) compared with previous lip adhesion method: a preliminary study of serial dental casts. Plastic and reconstructive surgery, 103(6), 1630-1644.
11. Sader, R. (2009). Lippen-Kiefer-Gaumen-Segelspalten. Pädiatrie up2date, 4(02), 183-205.
12. Sahoo, S. S., Dash, J. K., Sahoo, P. K., Das, S. K., Baliarsingh, R. R., & Ray, P. (2023). Early Orthodontic Intervention in Cleft Lip–Palate and Noncleft Children with Developing Class III Malocclusion: A Clinical Study. International Journal of Clinical Pediatric Dentistry, 16(5), 716.
13. Shaw, W. C., Brattström, V., Mølsted, K., Prahl-Andersen, B., Roberts, C. T., & Semb, G. (2005). The Eurocleft study: intercenter study of treatment outcome in patients with complete cleft lip and palate. Part 5: discussion and conclusions. The Cleft palate-craniofacial journal, 42(1), 93-98.
14. Sperber, G. H., & Sperber, S. M. (2012). Embryogenetics of cleft lip and palate. In Cleft lip and palate: Diagnosis and management (pp. 3-33). Berlin, Heidelberg: Springer Berlin Heidelberg.
15. Suri, S., Disthaporn, S., Atenafu, E. G., & Fisher, D. M. (2012). Presurgical presentation of columellar features, nostril anatomy, and alveolar alignment in bilateral cleft lip and palate after infant orthopedics with and without nasoalveolar molding. The Cleft palate-craniofacial journal, 49(3), 314-324.
16. Tian, H., Feng, J., Li, J., Ho, T. V., Yuan, Y., Liu, Y., ... & Chai, Y. (2017). Intraflagellar transport 88 (IFT88) is crucial for craniofacial development in mice and is a candidate gene for human cleft lip and palate. Human Molecular Genetics, 26(5), 860-872.
17. Vig, K. W., & Mercado, A. M. (2015). Overview of orthodontic care for children with cleft lip and palate, 1915-2015. American Journal of Orthodontics and Dentofacial Orthopedics, 148(4), 543-556.
18. Winnand, P., Ooms, M., Heitzer, M., Schaffrath, K., Pankert, T., Hölzle, F., ... & Modabber, A. (2024). Defining biomechanical principles in pre-surgical infant orthopedics in a real cleft finite element model. International Journal of Oral and Maxillofacial Surgery.
19. Yin, J., Zhang, S., Huang, N., Shi, B., Zheng, Q., & Yang, C. (2022). Short-term surgical outcomes in patients with unilateral complete cleft lip and palate after presurgical nasoalveolar molding therapy: A three-dimensional anthropometric study. Frontiers in Pediatrics, 10, 1101184.