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Article

Orthognathic Surgery in Adults with Craniofacial Clefts: Evaluating the Need for Maxillary Advancement and Facial Aesthetic Improvement

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Abstract

Background: Craniofacial clefts represent the most common congenital malformation in the head and neck region. Although most patients undergo primary cleft repair in childhood, many still present midfacial growth deficiencies in adulthood. This study aimed to evaluate and compare the incidence and indications for orthognathic surgery in adult patients with cleft lip (CL), cleft lip and alveolus (CLA), cleft lip and palate (CLP), and isolated cleft palate (CP). **Materials and Methods**: Sixty adult cleft patients (36 males and 24 females) born with a cleft and with a mean age of 19.51 ± 1.83 years were retrospectively enrolled in this study. All patients had undergone primary lip and palate repair during childhood at the Oral and Maxillofacial Surgery Service of "Mother Teresa" University Hospital Centre in Tirana. Clinical records, orthodontic documentation, and cephalometric data were reviewed to determine the indication for orthognathic surgery. **Results**: The statistical analysis showed that orthognathic surgery was deemed necessary in 30% patients, including ten males (56%) and eight females (44%). The most prevalent type of cleft was CLP, accounting for 35% of all patients, and it showed the highest surgical indication rate (83.3%). Cleft patients and the need for orthognathic surgery were evaluated according to the skeletal malocclusion in three planes. The need for surgery was more prevalent in patients with skeletal class III malocclusion with maxillary hypoplasia (83.3% of surgical cases), those with anterior and posterior crossbite (21.7% of all patients), and in deep bite patients (16.7% of all patients). Additionally, all patients with facial asymmetry (15%) required orthognathic surgery, highlighting the strong association between asymmetry and surgical indication. **Conclusions**: Patients with craniofacial cleft, especially those with CLP and combined maxillary deficiencies, demonstrate a significantly higher need for orthognathic surgery. Quantitative assessment supports the necessity of a multidisciplinary treatment approach to address persistent skeletal discrepancies and optimize functional and aesthetic outcomes in adult cleft patients.

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1. Introduction

The presence of craniofacial clefts accounts for approximately half of all craniofacial conditions across different geographic locations and ethnicities [1]. The highest incidence is observed in Asian populations, intermediate rates in Caucasians, and the lowest rates in African populations [1,2]. Males are more frequently affected than females by cleft lip and palate (CLP), with a ratio of approximately 2:1, and roughly 80% of cleft patients present with unilateral CLP, predominantly on the left side [3]. A craniofacial cleft is defined as a group of malformations of unknown etiology but similar phenotypes resulting from an interruption in embryogenesis during intrauterine facial development [3]. Craniofacial cleft may occur in isolation, particularly in non-syndromic cases, or as part of a spectrum of abnormalities in syndromic patients [4]. Syndromic and non-syndromic clefts demonstrate different and variable etiologies, therapeutic approaches, and prognoses [5].

Despite extensive research, the etiology of craniofacial cleft remains unclear, although the interplay of genetic and environmental factors is well established [3]. Clefts can range from simple or isolated clefts of the upper lip, with or without involvement of the alveolus, to complete unilateral or bilateral clefts of the lip and palate [6]. Notably, there are differences between unilateral and bilateral clefts in terms of the patients' overall health; individuals with bilateral clefts exhibit significantly more comorbidities than those with unilateral clefts [7].

A child born with a craniofacial cleft requires complex, long-term treatment, depending on the severity of the condition. Primary lip and palate repair is typically performed during infancy and early childhood and serves as the foundation for normal speech, occlusion, facial aesthetics, and self-esteem. Facial asymmetry is a major concern for cleft patients, and a primary goal of treatment is to restore symmetry [8].

One of the main drawbacks of primary cleft repair in the neonatal period is the potential for growth and developmental deficiencies in the midfacial complex [9]. The main factors contributing to maxillary deficiency are believed to include scar tissue formation in the growth centers of the maxilla, mouth breathing due to nasal airway obstruction [10], underdevelopment of the alveolar process due to missing teeth, and tension of the upper lip [11]. Midfacial deficiency, maxillary hypoplasia, and class III malocclusion in adult cleft patients often necessitate orthognathic surgery in adulthood [12]. This surgery, aimed at correcting maxillomandibular deformities, is typically performed after the completion of growth and may include maxillary advancement, distraction osteogenesis, or mandibular setback, combined with orthodontic treatment [12].

Furthermore, compared to the general population, patients with craniofacial cleft are more susceptible to dental anomalies [13,14]. This is a typical finding, as disruptions during various stages of tooth development (odontogenesis), such as morpho-differentiation and histodifferentiation, can result in both supernumerary teeth and agenesis [15]. The most common dental anomaly in the cleft region is agenesis of the maxillary lateral incisors, which is directly related to the local effects of the cleft [16].

Despite the symmetric and functional reconstruction of bone and nasolabial muscles achieved during primary surgery, dentoskeletal imbalances often persist and continue to cause problems throughout growth. Patients with clefts experience functional and aesthetic challenges and typically require multiple interventions as they mature [17]. Primary surgery aims to improve bite alignment, facial balance, and overall function in children affected by cleft lip (CL) and jaw-related concerns. However, many adult patients who underwent primary surgery during childhood report the need for additional procedures during growth or adulthood, such as orthognathic surgery [8].

Therefore, this study aimed to assess the need for orthognathic surgery in adult patients who had previously undergone primary surgery for craniofacial cleft, including those with only CL, CL and alveolus (CLA), CL and palate (CLP), submucous cleft (SC), and isolated cleft palate (CP).

2. Materials and Methods

The study was conducted following the principles of the Declaration of Helsinki (as revised). The Ethics Committee of Aldent University, Tirana, Albania, waived the need for approval for the present research protocol. All participants provided written informed consent before inclusion. All surgical and orthodontic treatments were performed as part of the patients' clinical care at the hospital by the institution's own medical and dental staff, in strict adherence to established treatment protocols.

Sixty adult cleft patients (36 males and 24 females) born with a cleft and with a mean age of 19.51 ± 1.83 years were retrospectively enrolled in this study. All patients had undergone primary lip and palate repair during childhood at the Oral and Maxillofacial Surgery Service of "Mother Teresa" University Hospital Centre in Tirana, Albania. The patients' primary surgeons varied, as did the previous cleft-related procedures that they performed. Most patients did not exhibit any cleft-associated syndromes.

Patient data analyzed included the following types of clefts:

- Cleft lip (CL);
- Cleft palate (CP);
- Cleft lip and palate (CLP);
- Cleft lip and alveolus (CLA);
- submucosal cleft (SC).

2.1. Classification of the Analyzed Cleft

CL is characterized by the openings of the lip that occur when the upper lip does not completely close during fetal development [18].

Openings in the palate characterize cleft palate (CP) and occur when an unborn baby's face and mouth are developing and the palate does not close fully [18].

Cleft lip and palate (CLP) is characterized by the absence of fusion or incomplete fusion of the maxillary and medial nasal processes [18].

Cleft lip and alveolus (CLA) is characterized by a fissure affecting variously the upper lip, the base of the nose, and the alveolar crest [18].

Submucosal cleft (SC) is characterized by insufficient median fusion of the soft palate muscles and sometimes a failure to weld the hard palate, with the oral and nasal mucosa generally unaffected [18].

2.2. Data Collection

Orthodontic records such as photos, lateral cephalograms, and dental casts were analyzed to assess the facial pattern and skeletal and dental malocclusion in all three planes of space.

Firstly, the type of cleft was defined to divide the patients, and the presence of unilateral and bilateral clefts was retrieved.

For the determination of skeletal anomalies in the sagittal plane (skeletal class and maxillary and mandibular protrusion/retrusion), a cephalometric analysis was performed for each patient. Measurements such as SNA, SNB, and ANB angles were retrieved to assess sagittal anomalies. Additionally, for vertical impairments, FMA (according to Tweed) and

SN-GoGn (according to Steiner) angles were evaluated. Both facial and dental asymmetries (normal, cross, or scissor bite) were evaluated. And the presence of unilateral and bilateral clefts was analyzed.

Dental malocclusion was also evaluated, assessing dental class (class I, class II, and class III), overjet (OJ), overbite (OB), and dental asymmetry. The number of congenitally missing teeth was also evaluated. The performance of early orthodontic treatment at a young age was reported, and the type of surgery was retrieved.

The need for orthognathic surgery was determined in a joint clinic by the orthodontist and maxillofacial surgeon. Then, information regarding the presence of orthodontic treatment performed during childhood and the type of orthognathic surgical treatment was collected.

2.3. Statistical Analyses

Descriptive statistics were calculated for all variables, considering absolute numbers and corresponding percentages. For all categorical variables (nominal, including binary/dichotomous and ordinal scale), absolute numbers and corresponding percentages were calculated. For all numerical variables, when the data were subject to a normal distribution, arithmetic means ± corresponding standard deviations were calculated. Differences between groups in discrete variables and non-parametric data were calculated using the Chi-square test or the Fisher exact test. The type I error rate was set as 0.05 for each test. All the collected data were analyzed with SPSS (Statistical Package for Social Sciences) version 19.0.

3. Results

Descriptive statistics of the initial demographic and clinical data of the patients were reported in Table 1.

Table 1. Descriptive statistics of the initial demographics.

Variable		CL (n = 12)	CLA (n = 5)	CLP (n = 21)	CP (n = 13)	SC (n = 9)	Total (n = 60)
Age		19.0 ± 1.5	19.4 ± 1.5	19.6 ± 2.0	20.0 ± 2.2	19.4 ± 1.7	19.5 ± 1.8
Sex	Males	58.3%	40%	61.9%	69.2%	55.6%	40%
	Females	41.7%	60%	38.1%	30.8%	44.4%	60%
Skeletal class	I	83.3%	60%	4.8%	30.8%	77.8%	41.7%
	II	0%	20%	4.8%	0%	11.1%	3%
	III	16.7%	20%	90.5%	69.2	11.1%	53.3%
Facial divergence	Normo	91.7%	60%	46.9%	69.2%	77.8%	65%
	Ipo	0%	0%	0%	0%	0%	0%
	Iper	8.3%	40%	57.1%	30.8%	22.2%	35%
Transverse malocclusion	Normal	58.3%	60%	23.8%	46.2%	77.8%	46.7%
	Crossbite	41.7%	40%	76.2%	53.8%	22.2%	53.3%
Cleft position	Unilateral	100%	100%	84.6%	90.5%	11.1%	80%
	Bilateral	0%	0%	15.4%	9.5%	88.9%	20%

Orthognathic surgery was necessary in 18 patients (30%), including 10 males (56%) and 8 females (44%). The most prevalent type of cleft was CLP (35% of all patients, Table 1). CLP patients had the highest need for orthognathic surgery (83.3% of all patients who needed surgery), while no need for surgery was seen in CL, CLA, and SC patients (Table 2).

Table 2. Descriptive statistics explaining the need for surgery in patients according to sex and different types of cleft.

Need Surgery				**Sex**		**Total**	***p* ***
				F	**M**		
No	**Cleft Type**	**CL**	Count	5	7	12	
			% of Total	11.9%	16.7%	28.6%	
		CLA	Count	2	3	5	
			% of Total	4.8%	7.1%	11.9%	
		CLP	Count	2	4	6	
			% of Total	4.8%	9.5%	14.3%	
		CP	Count	2	8	10	
			% of Total	4.8%	19.0%	23.8%	
		SC	Count	5	4	9	
			% of Total	11.9%	9.5%	21.4%	
	Total		Count	16	26	42	
			% of Total	38.1%	61.9%	100.0%	
Yes	**Cleft Type**	**CLP**	Count	6	9	15	
			% of Total	33.3%	50.0%	83.3%	
		CP	Count	2	1	3	
			% of Total	11.1%	5.6%	16.7%	
	Total		Count	8	10	18	
			% of Total	44.4%	55.6%	100.0%	
Total	**Cleft Type**	**CL**	Count	5	7	12	
			% of Total	8.3%	11.7%	20.0%	
		CLA	Count	2	3	5	
			% of Total	3.3%	5.0%	8.3%	
		CLP	Count	8	13	21	
			% of Total	13.3%	21.7%	35.0%	
		CP	Count	4	9	13	
			% of Total	6.7%	15.0%	21.7%	
		SC	Count	5	4	9	
			% of Total	8.3%	6.7%	15.0%	
	Total		Count	24	36	60	
			% of Total	40.0%	60.0%	100.0%	
							<0.001

* Pearson's Chi-square test of the need for surgery between different types of clefts.

Most of the analyzed patients had a unilateral location of the cleft (Table 3), and there were no statistically significant differences in the need for surgery between the patient groups.

Table 3. Descriptive statistics explaining the need for surgery in patients, depending on the presence of either a unilateral or bilateral cleft.

Cleft Location		Need for Surgery		Total
		No	Yes	
Bilateral	Count	2	2	4
	% of Total	3.3%	3.3%	6.7%
Median	Count	8	0	8
	% of Total	13.3%	0.0%	13.3%
Unilateral	Count	32	16	48
	% of Total	53.3%	26.7%	80.0%
Total	Count	42	18	60
	% of Total	70.0%	30.0%	100.0%

In the sagittal plane, patients with skeletal class III malocclusion and maxillary hypoplasia needed orthognathic surgery the most (Table 4).

Table 4. Descriptive statistics explaining the need for surgery in patients according to sagittal skeletal malocclusions and their different combinations.

Need for Surgery				Skeletal Malocclusion Sagittal Plane				
				Maxillary Hypoplasia	Maxillary Hypoplasia, Mandibular Prognathia	Maxillary Hypoplasia, Mandibular Retrognathia	Normal	Total
No	**Skeletal Class (sagittal plane)**	**Class I**	Count	5	0	0	20	25
			% of Total	11.9%	0.0%	0.0%	47.6%	59.5%
		Class II	Count	0	0	3	0	3
			% of Total	0.0%	0.0%	7.1%	0.0%	7.1%
		Class III	Count	14	0	0	0	14
			% of Total	33.3%	0.0%	0.0%	0.0%	33.3%
	Total		Count	19	0	3	20	42
			% of Total	45.2%	0.0%	7.1%	47.6%	100.0%
Yes	**Skeletal Class (sagittal plane)**	**Class III**	Count	15	3			18
			% of Total	83.3%	16.7%			100.0%
	Total		Count	15	3			18
			% of Total	83.3%	16.7%			100.0%
Total	**Skeletal Class (sagittal plane)**	**Class I**	Count	5	0	0	20	25
			% of Total	8.3%	0.0%	0.0%	33.3%	41.7%
		Class II	Count	0	0	3	0	3
			% of Total	0.0%	0.0%	5.0%	0.0%	5.0%
		Class III	Count	29	3	0	0	32
			% of Total	48.3%	5.0%	0.0%	0.0%	53.3%
	Total		Count	34	3	3	20	60
			% of Total	56.7%	5.0%	%	33.3%	100.0%

In the transverse plane, the most prevalent malocclusion in patients who need orthognathic surgery was anterior and posterior crossbite (21.7% of all patients) (Table 5).

Table 5. Descriptive statistics explaining the need for surgery in patients according to skeletal malocclusion of the transverse plane.

			Need Surgery		Total
			No	Yes	
Skeletal transverse discrepancy	Anterior and posterior crossbite	Count	4	13	17
		% of Total	6.7%	21.7%	28.3%
	Anterior and unilateral posterior crossbite	Count	0	1	1
		% of Total	0.0%	1.7%	1.7%
	Anterior crossbite	Count	7	1	8
		% of Total	11.7%	1.7%	13.3%
	Normal	Count	20	1	21
		% of Total	33.3%	1.7%	35.0%
	Posterior crossbite	Count	10	1	11
		% of Total	16.7%	1.7%	18.3%
	Unilateral posterior crossbite	Count	1	1	2
		% of Total	1.7%	1.7%	3.3%
Total		Count	42	18	60
		% of Total	70.0%	30.0%	100.0%

In the vertical plane, the most prevalent malocclusion was the deep bite (16.7% of all patients) (Table 6).

Table 6. Descriptive statistics explaining the need for surgery in patients according to skeletal malocclusion of the vertical plane.

			Need Surgery		Total
			No	Yes	
Skeletal divergence	Deep bite	Count	3	10	13
		% of Total	5.0%	16.7%	21.7%
	Normal	Count	33	5	38
		% of Total	55.0%	8.3%	63.3%
	Open bite	Count	6	2	8
		% of Total	10.0%	3.3%	13.3%
	Reverse deep bite left side	Count	0	1	1
		% of Total	0.0%	1.7%	1.7%
Total		Count	42	18	60
		% of Total	70.0%	30.0%	100.0%

All the cleft patients with facial asymmetry needed orthognathic surgery (15% of all patients) (Table 7).

Table 7. Descriptive statistics explaining the need for surgery in patients according to dental and facial asymmetry.

Need Surgery				Sex F	Sex M	Total
No	Symmetry	Dental Asymmetry	Count	5	11	16
			% of Total	11.9%	26.2%	38.1%
		None	Count	11	15	26
			% of Total	26.2%	35.7%	61.9%
	Total		Count	16	26	42
			% of Total	38.1%	61.9%	100.0%
Yes	Symmetry	Dental Asymmetry	Count	3	4	7
			% of Total	16.7%	22.2%	38.9%
		Facial Asymmetry	Count	4	5	9
			% of Total	22.2%	27.8%	50.0%
		None	Count	1	1	2
			% of Total	5.6%	5.6%	11.1%
	Total		Count	8	10	18
			% of Total	44.4%	55.6%	100.0%
Total	Symmetry	Dental Asymmetry	Count	8	15	23
			% of Total	13.3%	25.0%	38.3%
		Facial Asymmetry	Count	4	5	9
			% of Total	6.7%	8.3%	15.0%
		None	Count	12	16	28
			% of Total	20.0%	26.7%	46.7%
	Total		Count	24	36	60
			% of Total	40.0%	60.0%	100.0%

About 20% of the patients had at least one missing tooth, and 56.7% had none of the teeth missing (Table 8).

The impact of the orthodontic treatment during childhood does not statistically affect the need for surgery, as shown in Table 9.

The most frequent orthognathic surgery in cleft patients was bimaxillary surgery with maxillary advancement and mandibular setback osteotomy (16.7%) (Table 10).

Table 8. Descriptive statistics explaining the need for surgery in patients according to dental missing teeth.

			Need Surgery		Total
			No	Yes	
Congenital missing teeth (number)	**0**	Count	29	5	34
		% of Total	48.3%	8.3%	56.7%
	1	Count	7	5	12
		% of Total	11.7%	8.3%	20.0%
	2	Count	5	1	6
		% of Total	8.3%	1.7%	10.0%
	3	Count	0	1	1
		% of Total	0.0%	1.7%	1.7%
	4	Count	0	2	2
		% of Total	0.0%	3.3%	3.3%
	5	Count	1	3	4
		% of Total	1.7%	5.0%	6.7%
	8	Count	0	1	1
		% of Total	0.0%	1.7%	1.7%
Total		Count	42	18	60
		% of Total	70.0%	30.0%	100.0%

Table 9. Descriptive statistics explaining the need for surgery in patients according to orthodontic treatment in childhood.

Orthodontic Treatment		Need Surgery		Total	*p* *
		No	Yes		
Yes	Count	36	15	51	
	% of Total	60.0%	25.0%	85.0%	
No	Count	6	3	9	
	% of Total	10.0%	5.0%	15.0%	
Total	Count	42	18	60	
	% of Total	70.0%	30.0%	100%	
					0.559

* Results of the Fisher's exact test of the need for surgery between different types of clefts.

Table 10. Descriptive statistics of the different types of surgical treatment performed on the patients.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	**Bimaxillary**	10	16.7	16.7	16.7
	Le Fort I	4	6.7	6.7	23.3
	No surgery	42	70.0	70.0	93.3
	Preparing for surgery	1	1.7	1.7	95.0
	Refused surgery	3	5.0	5.0	100.0
	Total	60	100.0	100.0	

4. Representative Case

A 17-year-old female patient with a history of unilateral complete cleft lip and palate on the right side who was previously treated in childhood with primary closure of the defect presented for an evaluation. Her primary concern was aesthetic, stemming from the absence of anterior teeth and a malocclusion. Both medical and dental histories were unremarkable. Notably, the patient had not undergone alveolar bone grafting or received orthodontic treatment during childhood (Figures 1–10, Tables 11–14).

Figure 1. Pretreatment extraoral photographs: (**a**) right profile smiling, (**b**) frontal view, and (**c**) left profile in resting position.

Figure 2. Pretreatment intraoral photographs: (**a**) anterior and posterior crossbite in the frontal view, (**b**) cleft side unerupted teeth 12 and 13, (**c**) narrow V-shaped maxilla in the occlusal view, (**d**) and U-shaped mandibular arch with spaces in the lower jaw in the occlusal view.

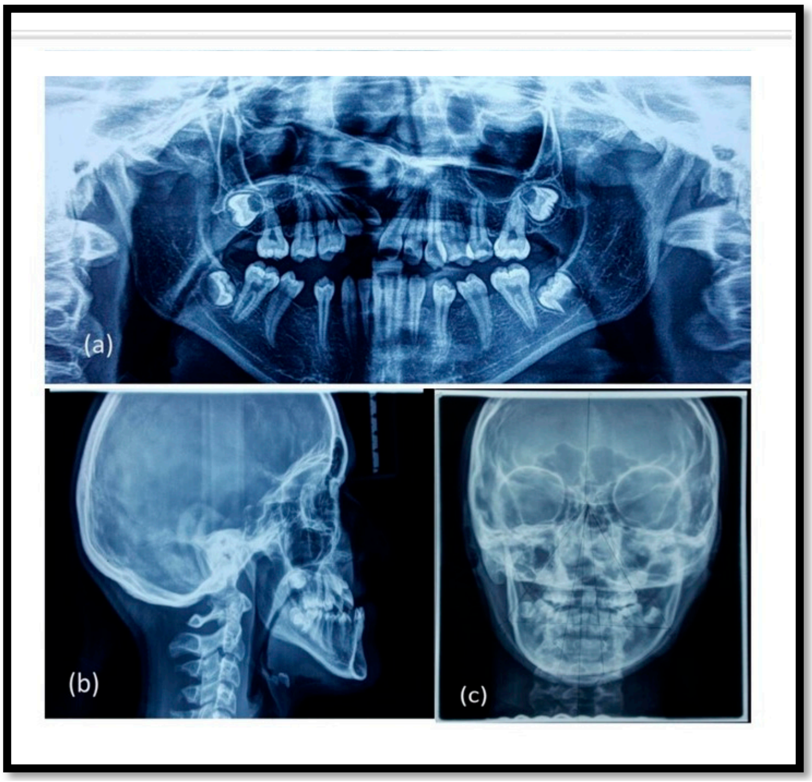

Figure 3. Before treatment radiographic imaging: (**a**) panoramic radiograph showing missing and unerupted teeth; (**b**) lateral cephalometric radiograph demonstrating retrognathic maxilla and skeletal class III malocclusion; (**c**) anteroposterior radiograph revealing mild facial asymmetry.

Figure 4. Extraoral photographs before orthognathic surgery: (**a**) right profile smiling, (**b**) frontal view, and (**c**) left profile in resting position.

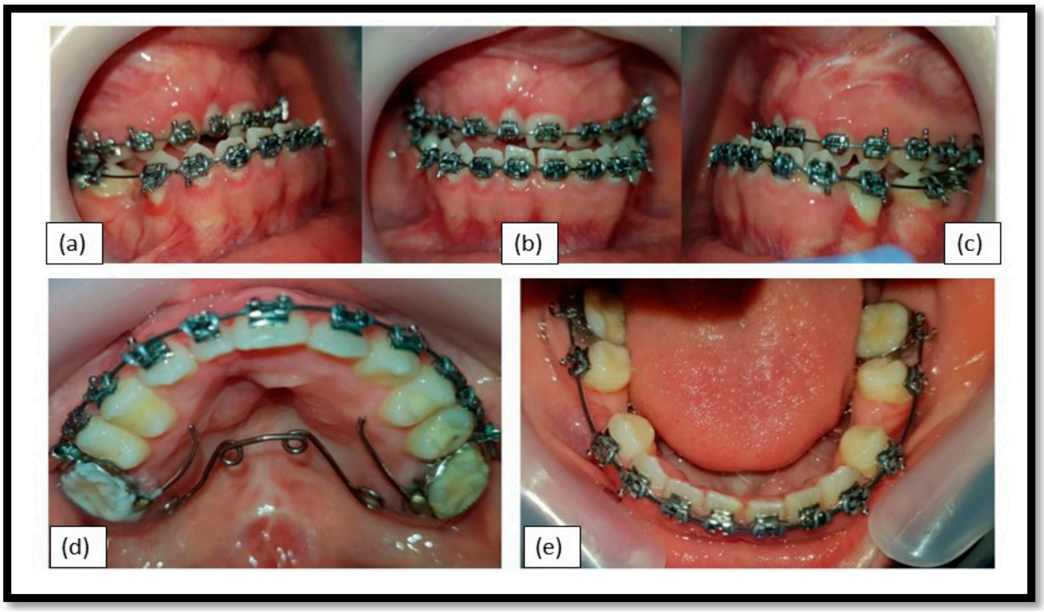

Figure 5. Intraoral photographs during orthodontic treatment: (**a**) right buccal view, (**b**) frontal view in occlusion, (**c**) left buccal view, (**d**) maxillary occlusal view, and (**e**) mandibular occlusal view.

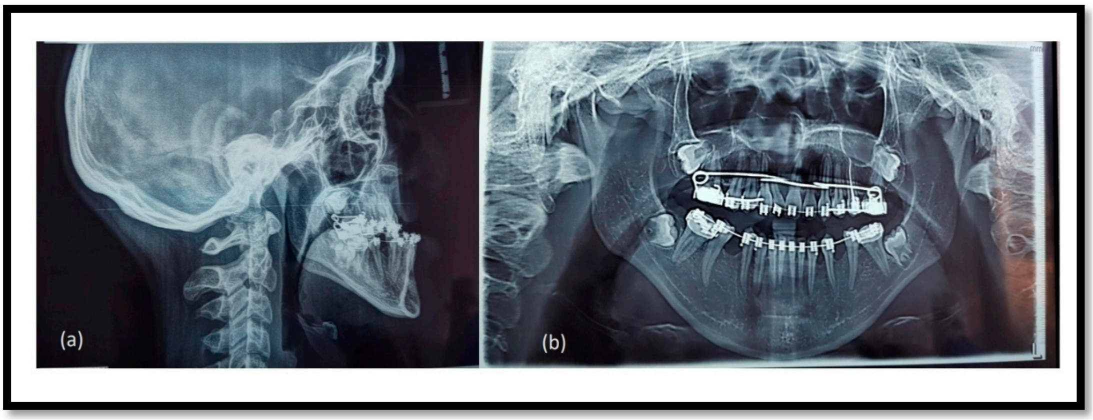

Figure 6. Lateral (**a**) and panoramic (**b**) x-rays during orthodontic treatment.

Figure 7. Extraoral photographs after orthodontic and orthognathic surgical treatment: (**a**) right profile, (**b**) frontal view smiling, and (**c**) left profile view.

Figure 8. Intraoral photographs after the braces are off and the composite restoration of teeth numbers #1.2 and #1.3: (**a**) right buccal view, (**b**) frontal view, (**c**) left buccal view, (**d**) maxillary occlusal view, and (**e**) mandibular occlusal view.

Figure 9. Extraoral photographs after orthodontic-orthognathic surgery and rhinoplasty: (**a**) right profile view, (**b**) frontal view smiling, and (**c**) left profile view.

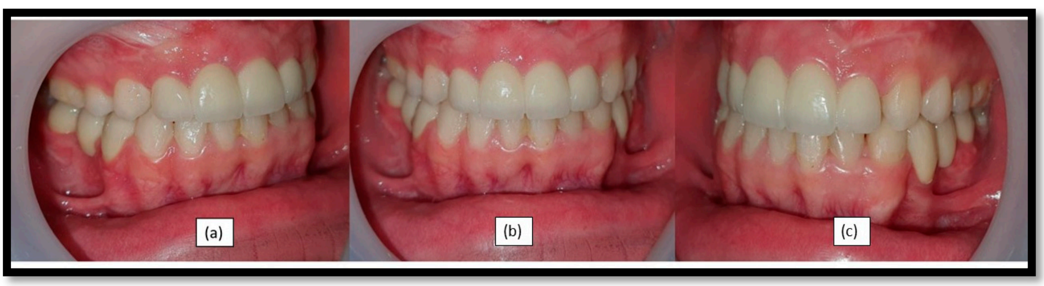

Figure 10. Intraoral photography at the end of the treatment after prosthetic restoration: (**a**) right buccal view, (**b**) frontal view, and (**c**) left buccal view.

Table 11. Extraoral analysis.

Facial Form	Mesoprosopic
Facial Symmetry	Mild asymmetry (nose asymmetry)
Chin Point	Does not align with the facial midline
Facial Profile	Concave
Facial Height	Upper facial height/lower facial height: reduced
Lips	Competent
Nasolabial angle	Reduced
Mentolabial sulcus	Deep

Table 12. Intraoral analysis.

Clinically present teeth	7 5 4 | 1 2 3 4 5 7 7 5 4 3 2 1 | 1 2 3 4 5 7
Unerupted/missing teeth	Unerupted third molars 1.3, 1.2. Unerupted 1.6, 2.6, 3.6, 4.6 and 1.1 missing
Molar relation	Unspecified, missing first molars
Canine relation	Class III left side Unspecified right side (unerupted 1.3)
Overjet	−7 mm
Overbite	−3 mm
Maxillary arch	Narrow V-shaped
Mandibular arch	U-shaped with spaces
Oral hygiene	Fair

Table 13. Cephalometric analysis.

Parameters	**Norms**	**Value**
SNA (°)	81 ± 3	76
SNB (°)	78 ± 2	81
ANB (°)	3 ± 2	−5
FMA (°)	25 ± 3	32
SN-GoGn (°)	33 ± 3	37
U1-NA (mm/°)	4 ± 22	26
IMPA	95 ± 5	80
U1-L1	132 ± 5	137

SNA: the angle between the A point (supra-spinal point of the maxilla), the nasion point (Na), and the S point (point in the center of sella), SNB: the angle between the B point (submental point of the jaw), the nasion point (Na), and the S point (point in the centre of sella), ANB: the angle between the A point, the Na point, and the B point; FMA: the angle formed by the intersection of the Frankfurt plane with the mandibular plane passing through gonion (Go) and menton (Me); SN-GoGn: the angle formed by the intersection of the SN plane with the plane passing through gonion (Go) and gnathion (Gn); U1-NA: the inclination of the upper incisor the angle between the long axis of the upper incisor and the plain NA; IMPA: the inclination of the lower incisor results of the angle between the long axis of the lower incisor and the mandibular; U1-L1: the angle resulting by the intersection of the plane passing through the long axis of the upper central incisor and one passing through the long axis of the lower central incisor.

Table 14. Treatment sequences (also reported in Figures 4–6).

Maxilla	Mandibula
Oral hygiene instruction and dental treatment of teeth with carious processes	
Bond quad helix appliance	none
After three months, bond fix braces	Bond fix braces
Dental alignment and leveling Decompensation of incisor inclinations Arch coordination Align impacted teeth 13, 12 and close spaces	Dental alignment and leveling Decompensation of incisor inclinations Arch coordination Maintain space of 36.46 for future prosthetic restoration
Preparation for surgery Splint fabrication (lab) Orthodontic anchorage, heavy archwires	
Le Fort 1 osteotomy with advancement	Bilateral Sagittal Splint Osteotomy surgery (mandibular setback)
Orthodontic treatment three weeks after surgery Intraoral elastic to stabilize the occlusion	
Braces off 8 months after surgery (Figures 7 and 8)	
13, 12 composite restorations Essix retainer	Fix retainer
4 months after braces off, Rhino plastic	
Prosthetic restoration with zirconia crowns in the upper jaw and metal-ceramic bridge in the posterior lower jaw	
Follow up at 6 months and one year after treatment (Figure 9)	

5. Discussion

Craniofacial clefts are among the most common facial deformities [1]. Their etiology is partly unknown, and they represent the leading cause of craniofacial deformities in newborns [3]. The presence of CLP and related clefts has significant implications for diagnosis, therapy, prevention, prognosis, and risk assessment [19]. Moreover, CLP can be associated with both syndromic and non-syndromic patterns, and early surgery aimed at promoting balanced growth of the skeletal and dental structures of the face is considered fundamental [19].

Despite early surgery, which is usually combined with orthodontic treatment during growth, performing additional combined orthodontic and surgical treatments in adulthood is often necessary [8]. The most common long-term problems associated with craniofacial clefts include nasal obstruction and mouth breathing, reduced maxillary growth, nasal asymmetry, and difficulty achieving symmetrical upper lip projection [20].

Considering these factors, the present study aimed to evaluate the need for orthognathic surgery in patients with different types of clefts. In the sample analyzed, nearly 18% of the enrolled patients required orthognathic surgery in adulthood. Since this study included different types of clefts, such as CLP, CP, CL, CLA, and SC, an additional objective was to explore which type appeared more frequently associated with the need for orthognathic surgery. Descriptive analysis suggested that patients with CLP had a higher rate of surgical treatment in adulthood. Although the number of patients with CLP was larger, it is important to understand this trend carefully, considering the retrospective nature of this study and the limited number of enrolled patients. This trend is consistent with previous findings suggesting that CLP is among the most complex cleft types, involving both soft tissue and skeletal components, which may contribute to a higher likelihood of requiring additional intervention beyond the primary surgery [21].

In our study, the presence of unilateral and bilateral clefts was assessed for the need for orthognathic surgery. Although no statistically significant difference was observed between the two groups, this finding must be carefully considered in light of the study limitations. The marked imbalance in group sizes, where unilateral clefts were considerably more prevalent, may have limited the statistical power to detect a potential difference. Therefore, the absence of statistical significance does not necessarily imply a true lack of association but may reflect a type II error due to the small sample size. Nonetheless, this trend is broadly in agreement with the findings reported in the majority of the literature [7,22].

Chouairi et al. [7] evaluated the operative course and perioperative outcomes in patients with unilateral versus bilateral cleft lip. In a cohort of approximately five thousand patients with cleft lip, they reported no statistically significant differences in complication rates, readmissions, or reoperations between the two groups [7]. It should be noted that, in the present analysis, submucous cleft was not considered, as it typically affects the midline region of the maxilla [23].

The presence of skeletal and dental malocclusion also influences the need for surgery in adulthood. We found that 83.3% of patients with the skeletal class III pattern and maxillary hypoplasia required surgical intervention. These findings are in line with the majority of studies in the scientific literature, which indicate that the most effective treatment for skeletal class III malocclusion with maxillary hypoplasia is combined orthodontic–orthognathic treatment, as it provides a more favorable and stable clinical outcome [8,24–26].

Similarly, malocclusions in the transverse and vertical planes showed comparable impacts. Patients with deep bite, as well as those with anterior and posterior crossbites, appeared more likely to require additional surgical interventions in adulthood. These trends did not reach statistical significance; therefore, these associations warrant validation through future research involving broader and more representative samples.

Finally, the presence of either dental or facial asymmetry did not statistically influence the overall need for surgery; however, it is noteworthy that all patients with facial asymmetry in this sample ultimately required surgical treatment.

Since the presence of clefts affects dental development, the occurrence of missing teeth was also evaluated. As is well known, clefts are among the most common causes of dental asymmetry in both young and adult patients [27]. The number of missing teeth in the evaluated sample ranged from zero to eight. Dental development is significantly delayed in patients with clefts compared to non-cleft populations [28].

Also, the impact of orthodontic treatment during childhood on the need for surgery in adulthood was assessed. Statistical analysis revealed no significant differences between patients who underwent orthodontic treatment during childhood and those who did not. In this study, approximately 33% of patients in both groups eventually required surgery. This is a noteworthy finding; however, the indication for orthodontic treatment in a child with a cleft must take into account many variables beyond the future need for surgery [29].

Moreover, clefts are often associated with syndromic patterns [5], and such patterns are more frequently observed in patients with bilateral clefts. Because patients with syndromes may also present with behavioral disorders, delivering consistent orthodontic treatment can be challenging. Furthermore, poor adherence to treatment is commonly observed in this population, which directly impacts treatment outcomes [30]. Therefore, it is important to understand that adherence, together with clinical and demographic factors, can guide clinical decision-making and support the development of interventions aimed at improving long-term results [31]. These considerations also align with recent evidence highlighting the emerging role of artificial intelligence (AI) in orthodontic planning and diagnostics [32,33]. In the context of cleft care, AI-driven tools can facilitate earlier and more precise identification of skeletal discrepancies, automate cephalometric analyses, and support predictive modelling for orthognathic surgery needs. For example, integrating AI algorithms with CBCT and digital dental records may allow clinicians to detect subtle growth patterns, such as early indicators of maxillary hypoplasia or asymmetry, that are not always apparent in conventional assessments. This could be particularly valuable for patients with complex cleft phenotypes, where individualized treatment timing and sequencing are critical to minimizing the number of interventions over a lifetime.

Despite the relevance of these findings, several limitations of the present study should be acknowledged. Firstly, the retrospective design of this study may introduce inherent biases, although patient recruitment was performed in strict chronological order to minimize selection bias. Secondly, the relatively small sample size may have limited the statistical power, particularly in subgroup analyses; therefore, future studies involving larger and more diverse cohorts are recommended. Additionally, the heterogeneity of the population in terms of cleft type and the inclusion of both syndromic and non-syndromic patients may affect the generalizability of the results and should be considered when interpreting the outcomes.

Assessing the surgical needs of patients with clefts requires a consideration of multiple interrelated clinical variables. In the present study, statistically significant associations were observed with complete CLP, facial asymmetry, and skeletal class III malocclusion accompanied by maxillary hypoplasia, factors that appeared more frequently among patients who required orthognathic surgery. While other conditions, such as anterior/posterior crossbites and deep bite, were also observed in this group, these did not reach statistical significance. The results underscore the value of early and tailored assessment in patients with craniofacial clefts and support the need for further research with larger cohorts to clarify the roles of additional variables.

6. Conclusions

Our investigation adds insight into surgical planning in cleft patients by identifying key clinical characteristics associated with orthognathic treatment needs. Patients with craniofacial clefts, especially those with CLP and combined maxillary deficiencies, demonstrate a significantly higher need for orthognathic surgery. These findings highlight the importance of a structured, individualized evaluation within a multidisciplinary care framework to optimize treatment outcomes.

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