

**Research Article**

## **Radiographic evaluation of the association between dental anomalies and cleft lip and palate**

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### **Abstract**

**Background:** Cleft lip and palate is a common craniofacial anomaly frequently associated with developmental dental abnormalities. Radiographic evaluation helps identify these anomalies and assists in comprehensive treatment planning. **Aim:** To evaluate the association between dental anomalies and cleft lip and palate using panoramic radiographs. **Materials and Methods:** A cross-sectional observational study was conducted among **95 patients** with cleft lip and/or palate. Panoramic radiographs were evaluated for dental anomalies including missing teeth, supernumerary teeth, impacted teeth, delayed eruption, microdontia, and positional abnormalities. Data were analysed using appropriate statistical tests, with  $p < 0.05$  considered significant. **Results:** Dental anomalies were detected in 78 (82.1%) patients. Unilateral cleft lip and palate was the most common cleft type (43.2%). Congenitally missing teeth were the most frequent anomaly (35.8%), followed by impacted teeth (18.9%) and supernumerary teeth (14.7%). The

maxillary lateral incisor was the most commonly affected tooth. A significant association was observed between cleft type and presence of dental anomalies ( $p=0.032$ ). **Conclusion:** Dental anomalies are highly prevalent among patients with cleft lip and palate. Panoramic radiographic evaluation provides valuable information for early diagnosis and multidisciplinary treatment planning.

**Keywords:** Cleft lip and palate; Dental anomalies; Panoramic radiography; Tooth agenesis; Radiographic evaluation.

### **Introduction**

Cleft lip and palate (CLP) is among the most frequently encountered congenital craniofacial malformations and results from incomplete fusion of the facial processes during embryonic development. It affects not only facial appearance but also feeding, speech, hearing, dentofacial growth, and oral health. The prevalence of cleft lip with or without cleft palate varies across different populations and is estimated to range from 1 in 500 to 1 in 1,000

live births. In India, the reported incidence is approximately 1 in 700 live births, making it an important health problem that requires coordinated management by specialists from multiple disciplines.<sup>1</sup>

Dental anomalies are commonly observed in individuals with cleft lip and palate and are considered an integral component of the craniofacial deformity. These abnormalities may involve the number, size, shape, eruption pattern, and position of teeth. Missing maxillary lateral incisors adjacent to the cleft site represent the most frequently reported anomaly, while supernumerary teeth, impacted teeth, delayed eruption, microdontia, ectopic eruption, and enamel defects are also encountered. The occurrence of these abnormalities can complicate orthodontic treatment, alveolar bone grafting, prosthetic rehabilitation, and overall treatment planning.<sup>2</sup>

The development of the lip, palate, and teeth occurs during the early weeks of intrauterine life. Any disturbance during this critical developmental period may simultaneously affect facial structures and tooth formation. Genetic factors, environmental influences, and disruptions in neural crest cell migration have all been implicated in the pathogenesis of cleft formation and associated dental anomalies. Because these structures share a common developmental origin, abnormalities in one are frequently accompanied by defects in the other.<sup>3</sup>

Radiographic examination is an indispensable part of the assessment of patients with cleft lip and palate. Panoramic radiography provides a comprehensive view of both jaws, allowing clinicians to identify missing teeth, supernumerary teeth, impacted teeth, delayed eruption, root

abnormalities, and other developmental disturbances. It is routinely used because it is simple, economical, and exposes patients to relatively low radiation. Radiographic evaluation also assists in monitoring dental development and planning orthodontic, surgical, and restorative procedures at different stages of treatment.<sup>4</sup>

Several studies have reported a significantly higher prevalence of dental anomalies in patients with cleft lip and palate compared with individuals without clefts. The type and frequency of these anomalies are influenced by the extent and location of the cleft. Patients with bilateral clefts generally exhibit a greater number of dental abnormalities than those with unilateral clefts. Early radiographic identification of these anomalies allows timely intervention, reduces treatment complexity, and improves long-term functional and esthetic outcomes.<sup>5</sup> Although numerous studies have evaluated dental anomalies associated with cleft lip and palate, information from the Indian population remains relatively limited. Differences in ethnicity, genetic background, and environmental factors may influence the pattern and prevalence of these anomalies. Therefore, radiographic evaluation of dental anomalies in patients with cleft lip and palate is important for understanding their distribution and association with various cleft types. The findings of such studies may help clinicians improve diagnosis, treatment planning, and multidisciplinary management of affected individuals.

## **Materials and Methods**

### **Study Design and Setting**

This hospital-based cross-sectional observational study was conducted in the Department of Dental in collaboration with the Oral Medicine and Radiology at a tertiary care dental teaching hospital. The study was carried out over a period of 12 months after obtaining approval from the Institutional Ethics Committee.

### Study Population

The study included **95 patients** diagnosed with cleft lip, cleft palate, or cleft lip and palate who reported to the outpatient department during the study period. Patients were selected using a consecutive sampling technique based on the eligibility criteria.

### Sample Size

A total sample size of **95 patients** was included in the study. The sample size was determined based on the availability of eligible patients attending the institution during the study period and was considered adequate to evaluate the association between dental anomalies and cleft type using radiographic findings.

### Inclusion Criteria

- Patients aged **6–25 years** with unilateral or bilateral cleft lip, cleft palate, or cleft lip and palate.
- Patients with panoramic radiographs of acceptable diagnostic quality.
- Patients who had not undergone extraction of permanent teeth for orthodontic or prosthetic reasons.
- Patients (or parents/guardians for minors) willing to provide written informed consent.

### Exclusion Criteria

- Patients with syndromic clefts or other craniofacial syndromes.
- Patients with poor-quality or distorted panoramic radiographs.
- Patients with a history of maxillofacial trauma affecting tooth development.
- Patients with systemic diseases known to influence dental development.
- Patients with incomplete demographic or clinical records.

### Radiographic Examination

Digital panoramic radiographs (orthopantomograms) were obtained using a standardized panoramic imaging system following the manufacturer's recommended exposure parameters. All radiographs were evaluated independently by two experienced oral radiologists under standardized viewing conditions. In cases of disagreement, a consensus diagnosis was reached through joint evaluation.

### Radiographic Assessment

The panoramic radiographs were examined for the presence of the following dental anomalies:

- Congenitally missing teeth (hypodontia)
- Supernumerary teeth
- Impacted teeth
- Delayed eruption
- Ectopic eruption
- Microdontia
- Tooth rotation or positional anomalies\
- Root malformations
- Transposition of teeth
- Other developmental dental abnormalities

The anomalies were recorded according to the affected tooth, dental

arch, side of involvement, and their relationship to the cleft site. Clefts were classified as unilateral right, unilateral left, bilateral cleft lip and palate, isolated cleft palate, or isolated cleft lip.

### Data Collection

Demographic variables including age and sex were recorded along with clinical information regarding the type and laterality of the cleft. Radiographic findings were entered into a structured data collection form specifically designed for the study.

### Outcome Measures

The primary outcome was the prevalence and pattern of dental anomalies detected on panoramic radiographs in patients with cleft lip and palate.

Secondary outcomes included:

- Association between cleft type and dental anomalies
- Distribution of anomalies according to age and sex.
- Frequency of anomalies adjacent to the cleft site compared with non-cleft regions.

**Table 1. Demographic characteristics of the study population (n=95)**

| Variable                 | Number (n) | Percentage (%) |
|--------------------------|------------|----------------|
| <b>Age Group (years)</b> |            |                |
| 6–10                     | 24         | 25.3           |
| 11–15                    | 35         | 36.8           |
| 16–20                    | 22         | 23.2           |
| 21–25                    | 14         | 14.7           |
| <b>Gender</b>            |            |                |
| Male                     | 55         | 57.9           |
| Female                   | 40         | 42.1           |

Most patients (36.8%) belonged to the 11–15-year age group, with a male predominance.

### Statistical Analysis

Data were entered into Microsoft Excel and analysed using IBM SPSS Statistics version 26.0. Continuous variables were expressed as mean  $\pm$  standard deviation (SD), while categorical variables were presented as frequencies and percentages. Associations between categorical variables were analysed using the Chi-square test or Fisher's exact test where appropriate. The independent Student's *t*-test or one-way ANOVA was used for comparison of continuous variables. A *p*-value of  $<0.05$  was considered statistically significant.

### OBSERVATION AND RESULTS

A total of 95 patients with cleft lip and/or palate were included in the study. The mean age of the participants was  $13.8 \pm 4.9$  years (range: 6–25 years). Males constituted 57.9% (n=55) of the study population, while females accounted for 42.1% (n=40). Dental anomalies were detected in 78 (82.1%) patients on panoramic radiographic examination.

**Table 2. Distribution of cleft type (n=95)**

| Cleft Type                      | Number (n) | Percentage (%) |
|---------------------------------|------------|----------------|
| Unilateral cleft lip and palate | 41         | 43.2           |
| Bilateral cleft lip and palate  | 20         | 21.1           |
| Isolated cleft palate           | 18         | 18.9           |
| Isolated cleft lip              | 16         | 16.8           |

Unilateral cleft lip and palate was the most common type, accounting for **43.2%** of cases.

**Table 3. Prevalence of dental anomalies detected radiographically (n=95)**

| Dental Anomaly                    | Number (n) | Percentage (%) |
|-----------------------------------|------------|----------------|
| Congenitally missing teeth        | 34         | 35.8           |
| Impacted teeth                    | 18         | 18.9           |
| Supernumerary teeth               | 14         | 14.7           |
| Microdontia                       | 13         | 13.7           |
| Delayed eruption                  | 11         | 11.6           |
| Ectopic eruption                  | 9          | 9.5            |
| Root anomalies                    | 8          | 8.4            |
| Tooth rotation/positional anomaly | 16         | 16.8           |

Congenitally missing teeth were the most frequently observed dental anomaly (35.8%), followed by impacted teeth (18.9%) and tooth rotation/positional anomalies (16.8%).

**Table 4. Association between cleft type and presence of dental anomalies**

| Cleft Type            | Dental Anomalies Present n (%) | Dental Anomalies Absent n (%) | Total     | p-value       |
|-----------------------|--------------------------------|-------------------------------|-----------|---------------|
| Unilateral CLP        | 35 (85.4)                      | 6 (14.6)                      | 41        |               |
| Bilateral CLP         | 19 (95.0)                      | 1 (5.0)                       | 20        |               |
| Isolated Cleft Palate | 12 (66.7)                      | 6 (33.3)                      | 18        |               |
| Isolated Cleft Lip    | 12 (75.0)                      | 4 (25.0)                      | 16        |               |
| <b>Total</b>          | <b>78 (82.1)</b>               | <b>17 (17.9)</b>              | <b>95</b> | <b>0.032*</b> |

\*Chi-square test; statistically significant ( $p < 0.05$ ). Dental anomalies were significantly more frequent in patients with bilateral and unilateral cleft lip and palate compared with isolated cleft lip or isolated cleft palate ( $p = 0.032$ ).

**Table 5. Distribution of congenitally missing teeth according to location (n=34)**

| Tooth Region               | Number (n) | Percentage (%) |
|----------------------------|------------|----------------|
| Maxillary lateral incisor  | 23         | 67.6           |
| Maxillary second premolar  | 5          | 14.7           |
| Mandibular second premolar | 3          | 8.8            |
| Other teeth                | 3          | 8.8            |

The maxillary lateral incisor adjacent to the cleft was the most commonly missing tooth, representing **67.6%** of all cases of tooth agenesis.

## Discussion

The present study assessed the association between dental anomalies and cleft lip and palate using panoramic radiographs in 95 patients. Dental anomalies were detected in 82.1% of the study population, indicating that developmental disturbances of the dentition are highly prevalent in individuals with cleft deformities. This finding is consistent with previous reports that have described a significantly higher occurrence of dental anomalies in cleft patients than in the general population.<sup>1,6</sup>

Unilateral cleft lip and palate was the most common cleft type (43.2%), followed by bilateral cleft lip and palate. This distribution is comparable to that reported by Mossey et al. and Paradowska-Stolarz, who identified unilateral clefts as the predominant clinical presentation.<sup>1,5</sup>

Congenitally missing teeth were the most frequent radiographic finding (35.8%), with the maxillary lateral incisor being the tooth most commonly affected. Similar observations have been reported by Silva Filho et al., Ranta, and Shapira et al., who

attributed this finding to disruption of odontogenesis in the cleft region during embryonic development.<sup>2,4,7</sup>

Impacted teeth (18.9%), supernumerary teeth (14.7%), and microdontia (13.7%) were also commonly observed. These findings agree with studies by Akcam et al. and Letra et al., which demonstrated that abnormalities in tooth eruption, number, and morphology are frequently associated with cleft lip and palate because of altered craniofacial growth and shared genetic influences.<sup>6,8</sup>

A statistically significant association was found between cleft type and the presence of dental anomalies ( $p = 0.032$ ). Bilateral cleft lip and palate showed the highest frequency of anomalies, followed by unilateral cleft lip and palate. Similar results have been reported by Paradowska-Stolarz and Ribeiro et al., suggesting that the severity of the cleft is directly related to the prevalence of dental developmental defects.<sup>5,9</sup>

Panoramic radiography proved to be an effective diagnostic method for identifying missing, impacted, and

supernumerary teeth, as well as other developmental abnormalities. Early radiographic evaluation enables appropriate orthodontic planning, surgical intervention, and prosthetic rehabilitation, thereby improving long-term functional and esthetic outcomes. The present study is limited by its single-center design and relatively small sample size. Nevertheless, the findings provide valuable information regarding the radiographic pattern of dental anomalies in cleft patients and support the routine use of panoramic radiography as part of comprehensive cleft assessment. Larger multicenter studies using three-dimensional imaging techniques may further clarify the relationship between cleft morphology and dental developmental abnormalities.

Overall, the present study confirms a strong association between cleft lip and palate and dental anomalies, with tooth agenesis being the most common finding. Routine radiographic evaluation should therefore be incorporated into multidisciplinary treatment protocols to facilitate early diagnosis and optimize patient management.

### Conclusion

The study revealed a high prevalence of dental anomalies in patients with cleft lip and palate, with tooth agenesis being the most common finding. Panoramic radiography was effective in detecting developmental dental abnormalities and is valuable for treatment planning. Early identification of these anomalies can improve multidisciplinary management and long-term outcomes in cleft patients.

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