



BACKGROUND

Cleft lip and/or palate (CL/P) is one of the most common craniofacial anomalies in the United States. The prevalence is 1 in 700 live births¹. The cause of cleft lip and/or palate is multifactorial involving both environmental and genetic factors¹. Diagnosis of CL/P is often made prenatally². Prenatal diagnosis is essential for parental preparation, surgical and multidisciplinary care planning and identifying other potential anomalies. A patient with a diagnosis of CL/P is typically followed by a craniofacial team where a multidisciplinary team is involved in the continuum of care.

CL/P classification is based on on side (left or right), laterality (unilateral or bilateral), severity (complete or incomplete) and anatomic involvement (lip, alveolus, and/or palate)³. There are multiple factors contributing to cleft severity. The cleft type and extent, location, size and associated health issues, A universal gold standard of measuring cleft severity does not exist. Indices have been developed to aid in classifying cleft severity pre-surgery in an attempt to predict surgical outcomes. The cleft severity index tool has been used in the literature as a reliable, reproducible method of measuring initial cleft severity⁴.

To date, there are no studies that have examined the correlation between initial cleft severity and dental crowding in the mixed dentition. Studies have examined the prevalence of dental anomalies in CL/P patients however limited studies have examined the correlation between initial cleft severity and dental anomalies. Therefore, the objective of this study was to assess if a correlation between initial cleft severity and dental anomalies exists in unilateral cleft lip and palate patients before undergoing alveolar bone graft surgery.

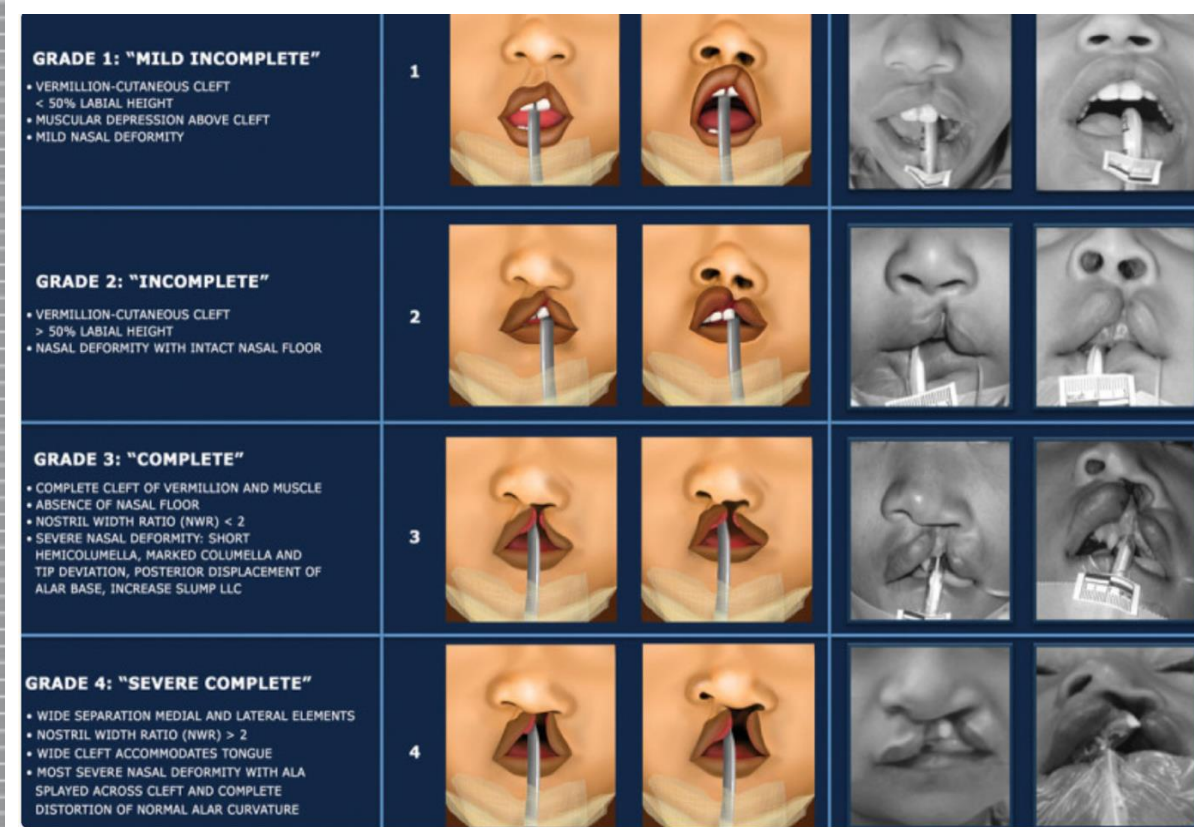


Figure 1 Cleft severity index tool⁴. Reprinted from reference⁴. This tool was used to assess initial cleft severity in non-syndromic unilateral cleft lip and palate patients.

MATERIALS AND METHODS

A retrospective chart review was performed among all non-syndromic unilateral cleft lip and palate patients seen at Children's Health between 2011 and 2025.

Inclusion criteria

- Diagnosis of non-syndromic unilateral cleft lip and palate
- Radiographs, digital models and/or photographs available

Exclusion criteria

- Diagnosis of bilateral cleft lip and palate
- Diagnosis of syndromic unilateral cleft lip and palate
- Existing radiographs, digital models and/or photographs unavailable

Clinical photos were used to assess cleft severity using cleft severity index tool. Dental crowding in the mixed dentition before alveolar bone grafting was measured using the tooth size length arch discrepancy method with digital models. Lastly dental anomalies were identified using radiographic records for each patient.



Figure 2 Initial cleft severity and dental crowding. An example of patient who had an initial cleft grade 4 at birth and subsequent severe crowding in the mixed dentition. The digital model was used to assess dental crowding with the tooth size length arch discrepancy method.

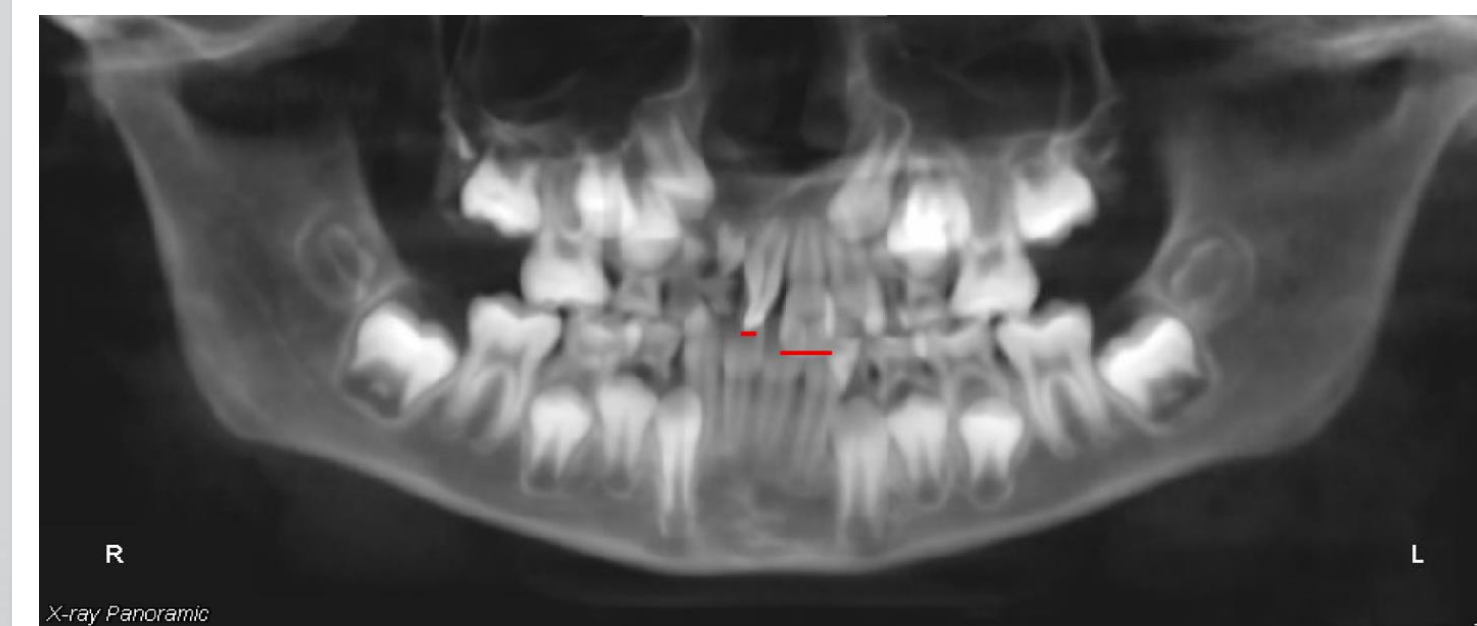


Figure 3 Central incisor rotation. Reprinted from patients' chart with IRB approval. Rotation of the right central incisor was noted on the right at the site of the cleft. The incisal edge of the contralateral central incisor was used as a reference point for rotation as shown above in red line marked.

RESULTS

A total of 76 (N=76) patients were included in this study. The Spearman's rank-order correlation was used to examine relationships between initial cleft severity, dental anomalies and dental crowding.

Maxillary dental crowding

A positive correlation with statistical significance exists between initial cleft severity and maxillary dental crowding. The spearman's rank correlation coefficient was 0.691 and the results were significant at $p=0.000$, $p<0.01$ (2-tailed).

Central incisor rotation

A positive correlation with statistical significance exists between central incisor rotation and initial cleft severity. The spearman's rank order correlation coefficient was 0.571 and the results were significant at $p=0.000$, $p<0.01$ (2-tailed).

Lateral incisor inclination

A positive correlation with statistical significance exists between lateral incisor inclination and location of lateral in the anterior cleft. The spearman's rank correlation coefficient was 0.908 and the results were significant at $p=0.000$, $p<0.01$ (2-tailed).

Canine inclination

A negative correlation with statistical significance between canine inclination and initial cleft severity. The spearman's rank correlation coefficient was -0.282 and the results were significant at $p=0.014$, $p<0.05$ (2-tailed).

There was no statistical significant relationship between initial cleft severity, central incisor malformation, ectopic 2nd premolar and missing 2nd premolar on the cleft side.

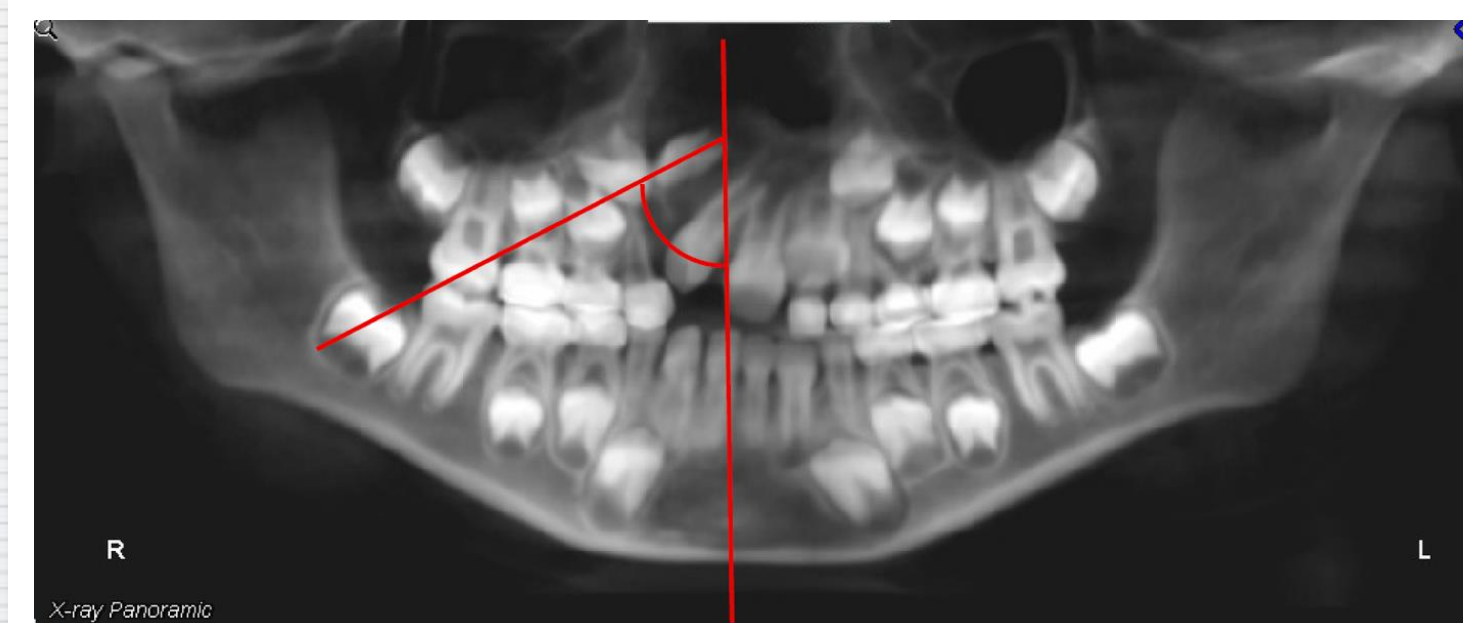


Figure 4 Lateral incisor inclination. Reprinted from patients' chart with IRB approval. This was determined by the angulation between the long axis of the lateral incisor and the midline as shown by the red line drawn.

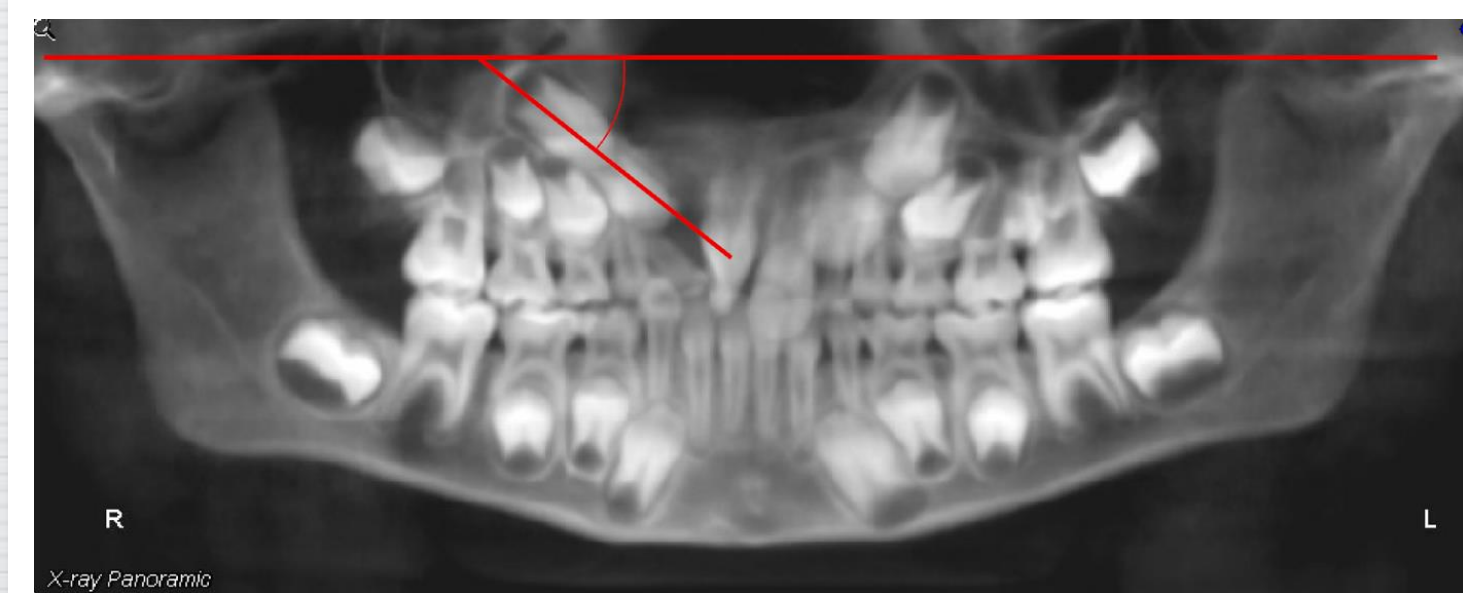


Figure 5 Canine inclination. Reprinted from patients' chart with IRB approval. This was determined by the angulation of the canine's long axis to the intercondylar line as shown by the red line marked.

DISCUSSION

Initial cleft severity and dental crowding

Initial cleft size influences early outcomes with regards to dental arch dimensions. The results of the study are supported by the literature in that larger clefts or more initially severe clefts lack tissue which leads to small arch circumference and subsequent maxillary dental crowding.

Initial cleft severity and central incisor rotation

Central incisor rotation increases with initial cleft severity. In a cleft, the central incisor is tethered to the lip musculature by the mucosa and maxillary frenum. Asymmetrical muscle forces from the face and lips can lead to rotation. Reduced arch circumference in dental crowding can lead to increased incisor rotation.

Initial cleft severity and lateral incisor inclination

Initial cleft severity correlates to increase in lateral incisor inclination and proximity of lateral incisor to the lesser segment in the anterior cleft. This is due to the embryonic origin of the lateral incisor. The failure of the medial nasal and maxillary process to fuse result in a cleft. The lateral incisor tooth bud originates from this area thus a cleft can affect the positional pattern of the lateral incisor.

Initial cleft severity and canine inclination

Initial cleft severity correlates with a decrease in canine inclination, in otherwords a more acute angle (<15 degrees) which translates clinically to increased likelihood of an impacted canine. This can be supported in the literature by the canine guidance theory. The canine guidance theory states that the canine uses the root of lateral incisor to guide its eruption. Therefore, the more altered the position and shape of lateral incisor in the cleft, the more acutely inclined a canine is and thus, increased likelihood of impaction.

Conclusion

1. In patients with non-syndromic unilateral cleft lip and palate, there is a significant relationship between initial cleft severity, dental crowding and dental anomalies.
2. The cleft severity index tool has a potential expanded use in a dental clinical setting to predict the severity of dental crowding and dental anomalies before patients undergo alveolar bone graft surgery.

REFERENCES

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3. Russell L, Long RJ, Romberg E. The Effect of Cleft Size in Infants With Unilateral Cleft Lip and Palate on Mixed Dentition Dental Arch Relationship. *Cleft Palate Craniofac J.* 2015;52(5):605-13.
4. Campbell A, Restrepo C, Deshpande G, Bernstein S, Tredway C, Wendby L, et al. Validation of the Unilateral Cleft Lip Severity Index for Surgeons and Laypersons. *Plast Reconstr Surg Glob Open.* 2017 Sep 13;5(9):e1479. doi: 10.1097/GOX.0000000000001479.