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**Comparative anatomy and morphometry of mandibular structures in neonates with congenital jaw anomalies: A retrospective study**Ankush Bhandari<sup>1</sup>, Sameep Mahendra Bumb<sup>2</sup>, Mahesh Eknath Pund<sup>3</sup>, Nilesh Barikrao Ubale<sup>4</sup><sup>1</sup>Lecture, Department of Oral and Maxillofacial Surgery, School of Dental Sciences, KVV, Karad, Maharashtra, India.<sup>2</sup>Lecturer, Department of Oral and Maxillofacial Surgeon, Sinhgad Dental College and General Hospital, Pune, Maharashtra, India.<sup>3,4</sup>Assistant Professor, Department of Oral and Maxillofacial Surgeon, GDCH, Chhatrapati Sambhajinagar, Maharashtra, India.**Email:** dr.ankushbhandari@yahoo.com, saamiiep@gmail.com, pundmahesh2@gmail.com, Nileshubale007@gmail.com**Article Information**

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**Keywords***3d Ct, Condylar Morphology, Congenital Jaw Anomalies, Mandibular Asymmetry, Mandibular Hypoplasia, Neonates.***ABSTRACT**

**Background and objective:** Neonatal function and aesthetics are critically affected by congenital jaw anomalies such as mandibular hypoplasia and condylar malformations. Accurate morphometric characterization in neonates is crucial to facilitate early diagnosis and planning for intervention. Thus, this study was conducted to compare anatomical and morphometric characteristics of mandibular structures in neonates. **Methods:** This retrospective observational study consisted of 80 neonates (40 each for congenital jaw anomalies and healthy controls). Three-dimensional computed tomography was utilized to quantify mandibular angle, intergonial distance, ramus height, condylar height, and upper-lower jaw distance bilaterally. Asymmetry and qualitative condylar morphology were measured. Statistical analyses consisted of t-tests, paired t-tests, and Chi-square tests, with significance established at  $p < 0.05$ . **Results:** Neonates with congenital jaw deformities had significantly lower mandibular angles ( $120.4^\circ \pm 5.7^\circ$  versus  $130.1^\circ \pm 4.9^\circ$ ,  $p < 0.001$ ), decreased intergonial distances ( $28.3 \pm 3.2$  mm versus  $33.7 \pm 3.5$  mm,  $p < 0.001$ ), and ramus ( $18.7 \pm 2.4$  mm versus  $22.9 \pm 2.8$  mm,  $p < 0.001$ ) and condylar heights ( $9.5 \pm 1.2$  mm versus  $12.3 \pm 1.4$  mm,  $p < 0.001$ ) than controls. The upper-lower jaw distance was enhanced ( $14.2 \pm 1.9$  mm versus  $11.5 \pm 1.6$  mm,  $p < 0.001$ ). There was noteworthy asymmetry in ramus height, gonial angle, and condylar height ( $p < 0.05$ ). Qualitative examination detected condylar hypoplasia in 50%, aplasia in 15%, and bifidity in 5%. **Conclusions:** Neonates with congenital jaw anomalies exhibit marked morphometric changes and asymmetry consistent with mandibular hypoplasia and condylar malformations.

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## 1. INTRODUCTION

The temporomandibular joint (TMJ) is a special bilateral ginglymus diarthrodial joint made up of the mandibular condyle and the temporal bone's articular eminence, which are divided by a fibrous disc into two compartments. Its bilateral character calls for symmetrical function of both sides, and the fixed mandibular connection does not permit unilateral movement (Laskin, 1980). Other unilateral and bilateral growth disturbances may involve the mandibular condyle and associated tissues, causing changes in size or shape that influence the function of the TMJ and produce facial deformity. Disturbances may be present in utero, especially later in the first trimester, and cause aplasia or hypoplasia of the condyle and surrounding soft tissues. Alternatively, disruptions during typical growth can lead to condylar hyperplasia because of abnormal stimulation of local growth (Kaplan and Assael, 1991).

Because of the variety of these abnormalities, various classifications have been put forward. The asymmetry related to condylar hyperplasia is classified into three types according to mandibular asymmetry. Mandibular hypoplasia can be divided into congenital, developmental, or acquired (Singh and Bartlett, 2005). Although some authors have studied syndromic congenital mandibular hypoplasia, research in non-syndromic patients is scarce. Despite the clinical relevance, extensive comparative studies on the thorough anatomy and morphometry of mandibular structures in neonates with congenital jaw anomalies are limited. The majority of literature focuses on older pediatric patients or syndromic conditions without a methodical morphometric process in the neonatal period (Kožejová Jaklová et al., 2024, Poortman et al., 2024). Thus, our study was conducted to compare the anatomical and morphological features of mandibular structures in neonates with congenital jaw anomalies.

## 2. MATERIALS AND METHODS:

**Study Design:** This retrospective observational study was conducted at the Department of Pediatric Dentistry, Faculty of Dentistry, the University.

Ethical approval was obtained from the University Faculty of Medicine Ethics Committee (Approval number). The study adhered to the principles of the Helsinki Declaration, and written informed consent was obtained from the parents or legal guardians of all neonates included.

### **Study Population and Inclusion Criteria:**

The study group consisted of 40 neonates diagnosed with congenital jaw anomalies, including mandibular hypoplasia, confirmed by clinical and radiological evaluation. Diagnoses were established by a multidisciplinary team including pediatric dentists, radiologists, and craniofacial surgeons. The control group included 40 healthy neonates without craniofacial anomalies, selected from routine neonatal screenings at the same institution.

### **Exclusion Criteria:**

Neonates with metabolic bone diseases, systemic illnesses, congenital syndromes involving multiple craniofacial anomalies (other than isolated mandibular hypoplasia), or poor-quality imaging that precluded accurate morphometric analysis were excluded. Neonates with previous surgical interventions on the mandible were also excluded. To minimize bias, neonates with syndromic conditions affecting craniofacial development other than isolated mandibular anomalies were excluded.

### **Data Collection and Imaging Protocol:**

All neonates underwent standardized three-dimensional computed tomography (3D CT) scans of the craniofacial region using the same imaging protocol and device to ensure consistency. Imaging parameters were optimized for neonatal safety and image quality. Morphometric measurements were performed on 3D reconstructed images by a single trained observer blinded to clinical status, using validated imaging software.

### **Morphometric Parameters:**

The mandibular parameters were measured bilaterally (Mandibular angle, Intergonial distance, Ramus height, Condylar height, Upper-lower jaw distance). Asymmetry was assessed by comparing left and right measurements within the congenital anomaly group. Qualitative assessment of condylar morphology (normal, hypoplasia, aplasia, bifidity) was performed based on established radiological criteria (Kaneyama et al., 2008).

### **Statistical Analysis:**

The analyses were conducted using SPSS software for Windows (version 15.0; SPSS, Chicago, IL). Group comparisons were performed using independent samples t-tests or Mann-Whitney U tests as appropriate. Asymmetry was evaluated using paired t-tests. Categorical variables (condylar

morphology) were compared using Chi-square tests. Interobserver reliability was assessed on a subset of 20% of images using intraclass correlation coefficients (ICC). Statistical significance was set at  $p < 0.05$ .

### 3. RESULTS:

#### Demographic Characteristics:

This study included 80 neonates (40 with congenital jaw anomalies and 40 healthy controls).

#### Morphometric Comparisons:

Neonates with congenital jaw anomalies showed significantly smaller mandibular angles ( $120.4^\circ \pm 5.7^\circ$  vs.  $130.1^\circ \pm 4.9^\circ$ ,  $p < 0.001$ ), reduced intergonial distances ( $28.3 \text{ mm} \pm 3.2$  vs.  $33.7 \text{ mm} \pm 3.5$ ,  $p < 0.001$ ), and shorter ramus ( $18.7 \text{ mm} \pm 2.4$  vs.  $22.9 \text{ mm} \pm 2.8$ ,  $p < 0.001$ ) and condylar heights ( $9.5 \text{ mm} \pm 1.2$  vs.  $12.3 \text{ mm} \pm 1.4$ ,  $p < 0.001$ ) compared to controls. The upper-lower jaw distance was increased in the congenital group ( $14.2 \text{ mm} \pm 1.9$  vs.  $11.5 \text{ mm} \pm 1.6$ ,  $p < 0.001$ ; Table 1)

**Table 1. Mandibular morphometric parameters in neonates**

Parameter	Congenital jaw anomalies (n=40)	Controls (n=40)	p-value
Mandibular angle ( $^\circ$ )	$120.4 \pm 5.7$	$130.1 \pm 4.9$	<0.001
Intergonial distance (mm)	$28.3 \pm 3.2$	$33.7 \pm 3.5$	
Ramus height (mm)	$18.7 \pm 2.4$	$22.9 \pm 2.8$	
Condylar height (mm)	$9.5 \pm 1.2$	$12.3 \pm 1.4$	
Upper-lower jaw distance (mm)	$14.2 \pm 1.9$	$11.5 \pm 1.6$	

#### Asymmetry:

Asymmetry was detected between the left and right sides within the group of congenital anomalies, with statistically significant differences in ramus height ( $p = 0.002$ ), gonial angle ( $p = 0.015$ ), and condylar height ( $p = 0.001$ ; Table 2).

**Table 2. Asymmetry of mandibular parameters in neonates with congenital jaw anomalies**

Parameter	Left side (Mean $\pm$ SD)	Right side (Mean $\pm$ SD)	p-value
Ramus height (mm)	$17.9 \pm 2.5$	$19.5 \pm 2.3$	0.002
Gonial angle ( $^\circ$ )	$118.7 \pm 5.9$	$122.1 \pm 5.3$	0.015
Condylar height (mm)	$8.9 \pm 1.3$	$10.1 \pm 1.1$	0.001

#### Condylar Morphology:

A qualitative evaluation revealed that 50% of neonates with congenital abnormalities had condylar hypoplasia, 15% showed condylar aplasia, 5% were found to have bifid condyles, while just 30% had normal condylar structure. Conversely, 95% of the control group exhibited normal

condyles ( $p < 0.001$ ; Table 3).

**Table 3. Qualitative assessment of condylar morphology in neonates**

Condylar morphology	Congenital jaw anomalies (n=40)	Controls (n=40)	p-value
Normal	30% (12)	95% (38)	<0.001
Hypoplasia	50% (20)	5% (2)	
Aplasia	15% (6)	0% (0)	
Bifidity	5% (2)	0% (0)	

#### Reliability:

The interobserver reliability for morphometric measurements was outstanding, with ICC values between 0.91 and 0.96.

### 4. DISCUSSION:

This research provides compelling morphometric evidence of significant mandibular variation in neonates with congenital jaw deformities. The congenital group exhibited typical features of mandibular hypoplasia, including a reduced mandibular angle, shortened intergonial distance, and lower heights of the ramus and condyle, alongside an increased distance between the upper and lower jaws. This aligns with prior studies indicating that mandibular hypoplasia originates from abnormal development of the first and second branchial arches during gestation, which can manifest either unilaterally or bilaterally and is frequently linked to syndromes such as Pierre Robin sequence, Treacher Collins syndrome, and hemifacial microsomia (Bhattacharya et al., 2015, Zimmerer et al., 2023).

The differences in the height of the ramus, gonial angle, and condylar height among individuals in the congenital group indicate that mandibular hypoplasia is often linked to uneven growth of the mandible, which is a typical trait seen in conditions like hemifacial microsomia and nonsyndromic hemimandibular hypoplasia (Bhattacharya et al., 2015, Zimmerer et al., 2023). This asymmetry holds significant clinical importance since it may influence both the timing and methods of surgical interventions, such as mandibular distraction osteogenesis (MDO), that aim to correct mandibular deficiencies and maintain airway openness (Flores, 2014, Frawley et al., 2013).

Qualitative analysis revealed that approximately 50% of neonates exhibited condylar hypoplasia, while a smaller percentage showed condylar aplasia or bifidity. This significant prevalence of condylar abnormalities reinforces previous findings that emphasize the critical role of the condyle in the growth and functioning of the mandible, as well as the issues associated with its malformation in cases of congenital mandibular hypoplasia (Remy et al., 2021). The presence of condylar hypoplasia may also contribute to long-term functional challenges

and complicate reconstructive procedures.

The limitations of this study consist of its cross-sectional nature, which restricts the ability to assess mandibular growth patterns and long-term outcomes. The sample size also poses a challenge for subgroup analyses, particularly regarding the influence of sex or specific syndromic conditions on mandibular morphology. Although the differences in mandibular size based on neonatal sex are generally minimal, future longitudinal studies should explore potential sex-specific growth patterns and their clinical significance. Furthermore, the wide range of congenital jaw malformations and their varied phenotypic expressions highlight the need for multicenter studies with larger participant groups.

## 5. CONCLUSION:

The present study reinforces the clinical value of precise morphometric evaluation in neonates with congenital jaw malformations. Early diagnosis of mandibular hypoplasia and asymmetry can direct early intervention that has proved to be an effective measure to reduce airway obstruction by protracting the mandible and repositioning the tongue, thus minimizing the requirement of tracheostomy in cases of Pierre Robin sequence. Nevertheless, although the benefits have been shown, MDO has risks such as infection, nerve damage, and potential disruption to mandibular growth, and careful patient selection and follow-up are required.

### Declarations:

### Conflict of Interest:

The authors declare no conflict of interest.

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