

# Incidental Findings on Cone-beam Computed Tomography in the Maxillofacial Region of Pediatric Patients: A Retrospective Study

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## ABSTRACT

**Aim and objective:** This study retrospectively evaluated the prevalence, type, and location of incidental findings (IFs) in the maxillofacial region of pediatric cone-beam computed tomographic (CBCT) scans with different sizes of the field of view (FOV).

**Methods and materials:** One hundred and forty CBCT scans of 7–18 years of patients carried out from February 2016 to June 2019 were obtained from the Department of Oral and Maxillofacial Radiology and retrospectively reviewed. The relevant findings were further categorized under airway, bony findings, congenital findings, endo lesions, orthodontic findings, dental developmental, and perio lesions. These findings were tabulated and subjected to statistical analysis.

**Results:** For all statistical tests, the value of  $p = 0.05$  was set as a statistical significance level. Among 140 patients, 75% of CBCT scans were performed between the age-group of 13 and 18 years, and the majority (35%) were taken with a single quadrant maxilla. The total IFs reported were 72.2% among the maximum were for orthodontic findings (23.8%) and least were for congenitally missing teeth (1.4%).

**Conclusion:** This study underscores the need to thoroughly search for clinically significant IFs within and beyond the region of interest for all CBCT volumes of data in children and assess for timely intervention.

**Clinical significance:** This study helps us to identify clinically significant IFs in children which will allow for early interventions, thereby strengthening the rationale of preventive pediatric dentistry.

**Keywords:** Cone-beam computed tomographic, Clinical indications, Incidental findings, Pediatric patients.

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## INTRODUCTION

In the last four decades, panoramic radiology has been quite efficient at providing significant details of oral and maxillofacial hard tissues, and related pathosis of jaws. However, magnification and minifications of structures, superimposition, and misrepresentation of structural entities are certain limitations since it is two dimensional.<sup>1</sup> Imaging in quality, as well as accessibility, has improved considerably with the introduction of a three-dimensional scanning procedure.

In 1997, cone-beam computed tomographic (CBCT) scanners were first developed in Italy which revolutionized the field of dentistry using a cone-shaped X-ray beam that perform a single rotation around the patient's head at a constant angle.<sup>1</sup> Compared to conventional tomography (CT), CBCT technology has been advantageous for various indications while allowing lower radiation dose, lower cost, and faster, easier image acquisition and display. Originally introduced for implant use, CBCT has capitalized all branches of dentistry, including pediatric applications.<sup>2</sup>

With the introduction of the DIMITRA project (dentomaxillofacial pediatric imaging: an investigation toward low-dose radiation-induced risks), justified use of CBCT in children is aimed to develop more patient-specific and indication-oriented recommendations. The DIMITRA consortium advocates to move from ALARA (as low as reasonably achievable) and ALADA (as low as diagnostically acceptable) toward ALADIP (as low as diagnostically acceptable being indication-oriented and patient-specific).<sup>3,4</sup>

"Incidental findings" (IFs) in radiology are routinely described as the unexpected discovery of a hidden entity during an imaging

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test. These findings are typically unrelated to the indication for the test.<sup>5</sup> Incidental findings in two-dimensional dental images as per various studies are identified in 6–43% of patients, however, with CBCT probability of IFs increases.<sup>6</sup>

There is considerable data available in relation to IFs in the adult population using CBCT; however, data regarding pediatric patients is insufficient due to lack of research evidence related to CBCT indications in children. Therefore, more data are required to identify these IFs in children which will allow for early interventions, thereby strengthening the rationale of preventive pediatric dentistry.

Thus, this study was undertaken retrospectively to evaluate the prevalence, type, and location of IFs on CBCT of the maxillofacial region in pediatric patients.

## MATERIALS AND METHODS

### Study Design

This cross-sectional and observational research study was conducted in the department of Oral and Maxillofacial Radiology in ITS Dental College and Research Centre, Greater Noida, India wherein 140 CBCT scans of the sample between the age-group 7 years and 18 years were taken. Data were secondarily obtained with approval from the Department of Oral and Maxillofacial Radiology. The cone-beam images were acquired using a CARESTREAM (Kodak.90003D) flat panel-based CBCT machine. All scans were reviewed by the maxillofacial radiologists using the imaging software InVivoDental 5.0 (Anatomage, San Jose, CA, USA). The CBCT scans of children conducted between February 2016 and June 2019 were retrieved after the patient's consent and retrospectively reviewed for IFs, hence ethical clearance for this study was not necessary. Patients referred for III molar evaluation and scans with artifacts were excluded. The findings unrelated to the primary purpose of the scan were taken as IFs.

Images with the field of view (FOV) involving only the single quadrant maxilla/mandible  $5 \times 5$  cm, images with FOV  $5 \times 10$  cm high involving single arch maxilla/mandible; images with FOV  $10 \times 10$  cm high involving both the maxilla and mandible and TMJ scans with FOV  $8 \times 8$  cm high were included. The diagnosis was based entirely on CBCT findings with no additional clinical, radiographic, or histological information used. All the scans were reviewed and the type and prevalence of IFs were detected in the maxillofacial region. Thereafter, clinical significance was evaluated. The relevant findings were further categorized under airway, bony findings, endodontic, developmental, orthodontic, and periodontic findings. The findings were tabulated and subjected to statistical analysis using the Pearson Chi-square test.

## RESULTS

This study was conducted on 140 scans of which 67 were that of males and 73 that of females between 7 years and 18 years with 25% of children below 13 years and 75% among 13–18 years. The frequency distribution of area of concern according to FOVs used. Maximum scans were taken with a single quadrant ( $5 \times 5$ ) maxilla (35%) followed by full arch maxilla ( $5 \times 10$ ) accounting for about 26.4%. The least scans recorded were of TMJ ( $10 \times 10$ ) with only 7.1% of total scans. All IFs recorded in the maxillofacial region in CBCT scans were grouped under different categories (Table 1). The total IFs reported were 72.2%, among which the maximum was for orthodontic findings (23.8%) and least for were congenital missing teeth (1.4%) (Fig. 1). Frequency IFs of maxillofacial region in CBCT scans GS INCI.

### Number of IFs and Age-group

Incidental findings were found more in the age-group of 13–18 years; however, no significant result was found.

### Number of IFs and Gender

There was statistically no significant result for IFs and gender but females showed slightly higher prevalence.

**Table 1:** Description of incidental findings of the maxillofacial region of CBCT

Airway area
Mucosal thickening
Deviation of the nasal septum
Oro-antral communication
Antral polyps
Meatal obliteration
Sinus antrolith
Spared sinus
Bony findings
Osteomyelitis
Idiopathic osteosclerosis
Impacted teeth
Premolar
Canine
Lateral incisor
Endo lesion
Periapical rarefactions
External root resorption
Fractured teeth
Caries
Developmental findings
Supernumerary teeth
Odontome
Fusion of roots
Perio lesion
Root dehiscence
Bone loss

## Correlation of CBCT Indication with IFs

About 50% congenitally missing teeth were found in patients with bony lesions. Bony IFs were about 15.4% in patients screened for bone lesions and 53.8% findings for implant placement. Almost 25% of IFs related to developmental were reported in scans indicated for orthodontic purposes.

The overall prevalence of IFs was 72.2% of which orthodontic findings were maximum (23.8%). Out of these, canine impactions were the most frequent finding.

## DISCUSSION

Cone-beam computed tomographic scans are used as an advanced imaging technique for many diagnostic applications in dental and maxillofacial structures. The advantage is obtaining an image of high accuracy with a submillimeter resolution with a radiation dose markedly lower than conventional computed tomography (CT).<sup>7</sup> Thus with more accurate data, chances of procuring IFs become more. Various studies about IFs on CBCT scans have been done to date but very little data is present about children and young individuals that will articulate the significance of these findings in them. The limited data can be attributed to the ethical reasons for the acquisition of CBCT scans in children.

In the present study, 140 scans between the age-group of 7 years and 18 years referred from various departments with varied

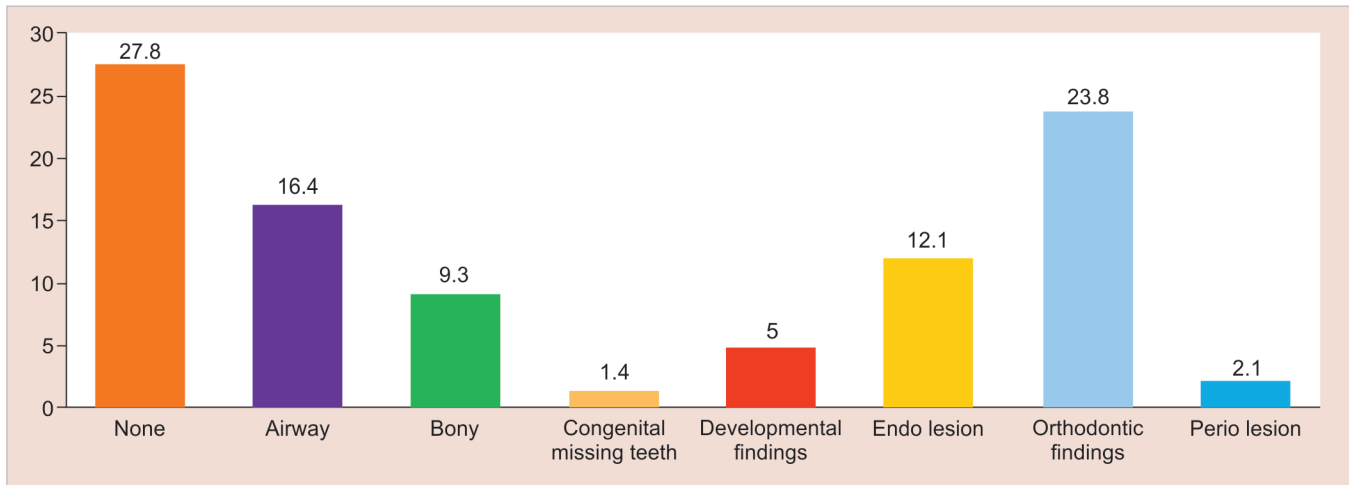


Fig. 1: Frequency distribution of incidental findings of maxillofacial region in CBCT scans

indications were retrieved and analyzed for IFs. Limited scans can be justified for this age-group with children being vulnerable to higher radiation doses. Thus, following the optimization principle, efforts were made to obtain good quality images with lower exposures in younger children.<sup>2,4,8,9</sup> Scans were further grouped under age 7–12 and 13–18 years with maximum scans obtained from age-group 13–18 years. As most of the scans referred in this age-group were for orthodontic purposes, thus correlating with the usual age where treatment for malocclusion may be initiated.<sup>2</sup>

Most of the CBCT scans retrieved were of a single quadrant (35% in the maxilla) with limited FOV justifying guidelines set by AAPD (ALARA principle). The result corroborates with the study by Lopes et al.<sup>10</sup> where CBCT scans of maxilla from the majority group. Most of the cases subjected for CBCT scans were for orthodontic purposes (36%) which included scans for localization of teeth/impacted teeth (17%) with the least scans for cleft lip and palate patients (2%).

In our study, the total percentage of incidental findings was about 72.2%. The results were comparable to that of the studies done by Caglayan and Tozoglu (92.8%)<sup>11</sup> and Price et al. (90.7%)<sup>12</sup> and stood in contradiction to the results by Cha et al.<sup>13</sup> which was only 24.5%. The difference can be attributed to the radiologist reporting style.

### Airway Area

In our study, 16.4% of IFs were reported in the airway region where thickening of mucosal lining and deviation of nasal septum were predominant findings. The results were comparable with the studies by Edward<sup>5</sup> which was 8% and Smith where about 19.4% of IFs were reported.<sup>8</sup> Most of the airway findings were reported in patients who were subjected to scans for orthodontic purposes (47.80%). The results can be compared with Cha et al. who reported 18.8% of airway findings mainly found in orthodontic patients.<sup>11</sup> Other IFs reported in the airway region were antral polyps, meatal obliteration, sinus antrolith, and oro-antral communication. The mucosal thickening can lead to airway obstruction and the possible cause may be malocclusion, odontogenic infections, and disharmonious dentofacial development.<sup>10</sup> Mucosal thickening of >3 mm (Ruprecht and Larn) or 4 mm (Macdonalds) is considered pathologic.<sup>9,14</sup> Cone-beam computed tomographic scans can provide us details and help in assessing the sinus changes, thus can be considered as a standard tool in the screening of airway abnormalities.<sup>15</sup>

### Bony Findings

The total distribution of IFs in the bony area was 9.3%, whereas secondary osteomyelitis and idiopathic osteosclerosis were reported. Similar findings were appreciated by Allareddy et al.<sup>1</sup> where two cases of osteomyelitis and five cases of idiopathic osteosclerosis were reported. Price et al. reported 17.5% of bony findings in 111 patients which included idiopathic osteosclerosis, torus palatinus, mandibular tori, osteoma, and stafne bone defect.<sup>12</sup>

### Orthodontic Findings

23.8% of total IFs were reported in patients referred for various orthodontic reasons which included those sent for solitary impaction, i.e., localization of tooth and for other reasons of malocclusion (Table 2). Among impacted teeth, the canine was the most frequent finding (excluding the third molar). Jena et al. and Fardi et al. also reported impacted canines being the most common impacted teeth.<sup>11,16,17</sup> Most orthodontic related IFs were seen in the age-group of 13–18 years corresponding to the results by Rivas et al.<sup>2</sup>

### Developmental Findings

In the present study, IFs related to developmental anomalies accounted for 5% which included supernumerary teeth, odontoma, the fusion of roots, root dilacerations, congenitally missing. Supernumerary teeth were the major findings reported (2.8%), wherein mesiodens being the commonest type. The findings were similar to results by Lopes et al., Rai et al., and Allareddy et al.<sup>1,10,18</sup> Among the 1.4% of congenitally missing teeth, premolar teeth were the predominant ones. The overall prevalence of congenitally missing teeth is reported to be 4% wherein mandibular pre-molars (excluding III molars) are found frequently missing. Thus, the present study was in accordance with studies by Uner et al. and Moyers et al.<sup>19,20</sup>

WHO recognizes odontoma as the most common odontogenic tumor (35–76%)<sup>21</sup> in which compound odontome are more frequently found (9–37%) than complex odontome. Thus, our results can be well correlated where compound odontome was a major IF among the odontomas.

### Endodontic Lesion

Among 12.1%, the major IFs were that of periapical rarefactions which included granulomas, cysts, and abscesses. These results can

**Table 2:** Correlation of CBCT indications with incidental findings

	CLP (%)	TMJ abnormalities (%)	Bone lesion (%)	Developmental defect (%)	Endo lesion (%)	Orthodontic purposes (%)	Implant (%)
None	0.00	3.20	3.20	3.20	9.70	41.90	38.70
Airway	8.70	0.00	17.40	0.00	21.70	47.80	4.30
Bony	0.00	0.00	15.40	7.70	7.70	30.80	53.80*
Congenitally missing teeth	0.00	50.00*	50.00*	0.00	0.00	0.00	0.00
Developmental	14.30	0.00	0.00	14.30	14.30	42.90	14.30
Endo findings	0.00	0.00	5.90	0.00	41.20	11.80	41.20
Orthodontic findings	0.00	0.00	18.70	25.00	6.20	68.80*	15.60
Periodontic findings	0.00	0.00	0.00	0.00	0.00	0.00	100.00*

be well compared with studies by Price et al., Nakata et al., and Patel et al. who reported CBCT as a superior investigation for a previously undiagnosed periapical lesion in the conventional radiograph.<sup>12,22,23</sup> Other incidental endodontic findings reported were external root resorption, fractured teeth, and caries.

### Periodontic Lesion

About 2.1% of IFs related to periodontal problems were reported which included root dehiscence, bone loss, rarifying osteitis. All patients referred for implant assessment had periodontal-related IFs (Table 2). Allareddy et al. reported higher degenerative findings seen in CBCT implant assessment followed by the orthodontic problem.<sup>1</sup>

In cases with cleft lip and palate, congenitally missing teeth and airway findings were the main IFs.

The present study although had certain limitations which included the limited FOV leading to incomplete estimation of the airway and sinus findings and even incidental TMJ findings could not be assessed.

### CONCLUSION

This study further substantiates the presence of IFs in maxillofacial CBCT scans in children which explains the need for dental practitioners to identify clinically relevant lesions and comprehensively assess for timely interventions.

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