ANATOMICAL VARIATIONS FINDINGS ON CONE BEAM-COMPUTED TOMOGRAPHY IN CLEFT LIP AND PALATE PATIENTS

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Abstract

Introduction: Cone beam computed tomography (CBCT) is frequently used in surgery treatment planning in patients with cleft lip and palate (CLP). The aim of this study was to investigate the presence of different anatomical variations of patients with cleft lip and palate using CBCT images.

Materials and method: CBCTs taken from consecutive patients (n =25; mean age 10.7±4 years, range 6.5–23 years) with a non-syndromic cleft lip and palate (CLP), between June 2014-2015, were systematically evaluated. Sinuses, nasopharynx, oropharynx, hypopharynx, temporo-mandibular joint (TMJ), maxilla and mandible were checked for incidental findings.

Results: On 90.1 % of the CBCTs, incidental findings were found. The most prevalent ones were airway/sinus findings (78.1%), followed by dental problems, e.g. missing teeth (54%), nasal septum deviation (93%), middle ear and mastoid opacification, suggestive for otitis media (8%) and (chronic) mastoiditis (7%), abnormal TMJ anatomy (4.3%).

Conclusions: Incidental findings are common on CBCTs in cleft lip and palate patients. Compared with the literature, CLP patients have more dental, nasal and ear problems. The CBCT scan should be reviewed by all specialists in the CLP team, stress being laid on their specific background knowledge concerning symptoms and treatment of these patients.

Keywords: cone beam CT, anatomy, cleft lip and palate

1. INTRODUCTION

Three-dimensional imaging techniques are increasing in importance compared with conventional radiological imaging techniques, not only in routine diagnostics of head and neck, but also in parts of the body which require particular care in terms of radiation hygiene [1]. Special attention must therefore be paid to limiting radiation exposure, especially in younger patients, e.g. those with cleft lip and palate.

Cone beam computed tomography (CBCT) was introduced in dentistry in 1997. Since then, CBCT has found its way for various applications within the dental field, mainly due to its lower radiation dose.

CLP patients concern a relatively young group of patients known to have more ear, nose and throat (ENT) problems [2–5] than children without clefts, because of the different anatomy of the Eustachian tubes, soft palate muscles and nose. This different anatomy gives rise to middle ear disease, nasal breathing and speech problems [2,3,5]. Furthermore, the prevalence of dental anomalies (agenesis, supernumerary teeth) is higher in CLP patients - compared to a non-cleft population [3-5].

Though it is expected that cleft lip and palate (CLP) patients could be subjected to a CBCT scan at some point during their treatment, no study has been published yet on incidental findings on CBCT in this particular group of patients. CLP patients may get a CBCT for planning an alveolar bone graft procedure (ABG), as well as for planning orthognathic surgery.

The present study aimed at investigating the presence of different anatomical variations in patients with cleft lip and palate, using CBCT images.
2. MATERIALS AND METHOD

All first consecutive CBCTs of patients with non-syndromic lip and palate clefts (n = 25; 15 girls, 10 boys), taken between June 2014 and June 2015, were systematically evaluated. The reason for CBCT was planning of the alveolar bone graft procedure or orthognathic surgery.

The population under study (n = 25 patients; mean age 10.7±4 years, range 6.5–23 years) included 21 subjects with unilateral cleft lip, alveolus and palate (UCLP) and 4 subjects with bilateral cleft lip, alveolus and palate (BCLP).

The study protocol was reviewed and approved by the Ethics Committee of the Faculty of Dentistry, “Gr. T. Popa” University of Medicine and Pharmacy, Iasi, Romania. Before the CBCT scan, patients’ parents were fully informed on the purpose of this study and on the risks associated with CBCT.

The equipment used was PlanmecaPromax 3D CBCT Mid (Planmeca OY, Helsinki, Finland). Scanning was performed by selecting a 200 x 170 mm view field, and following the exposure parameters: 90 kV, 12 mA, 13.8 sec and 0.4 x 0, 4x 0, 4 mm voxel size. DICOM files were imported into Romexis 3.0.1 (Planmeca OY, Helsinki, Finland), a software capable of volume rendering. To achieve axial, coronal and sagittal sections, the CBCT reconstructions were established with a thickness of 1 mm, at a distance of 1 mm.

A well-calibrated oral radiologist with experience in tomographic appraisal performed the assessment of the CBCT images, according to a standardized protocol, in which all structures were screened in the same order (anatomical areas): 1) frontal, ethmoid, sphenoid and maxillary sinuses; 2) nasopharynx, oropharynx, hypopharynx; 3) temporomandibular joint (TMJ); 4) maxilla and 5) mandible. All findings seen on a CBCT were scored.

Descriptive statistics was used to describe the occurrence of incidental findings. Chi-square tests were used to test the possible differences between the two distinct types of clefts with the largest sample size, i.e. BCLP (4) and UCLP (21).

3. RESULTS

On 90.1 % of the CBCTs, incidental findings were found. Even if excluding dental problems (agenesis, impaction, supernumeraries, caries), incidental findings were still found on 85.3 % of the CBCTs. Most of the findings were related to sinuses, of which 78.1 % were mainly different types of mucosal thickening (polipoid, flat, air-fluid levels; Table 1); 35% of the patients had mucosal thickening in all sinuses, suggestive for pansinusitis (Fig. 1).

Concerning the nasal cavity, 93% of patients had septum deviation (Fig. 2), 34% - concha bullosa, 9% of them had enlarged tonsils, 8% of patients had middle ear opacification, suggestive for otitis media, and 7% - mastoid opacification, suggestive for chronic mastoiditis.

In 4.3 % of all patients, the mandibular condylar head was either a remarkably smaller condyle or a flattened one, compared to the other side.

Table 1. Incidental findings related to sinuses

<table>
<thead>
<tr>
<th>Findings</th>
<th>Frontal sinus</th>
<th>Sphenoid sinus</th>
<th>Ethmoidal sinus</th>
<th>Maxillary sinus</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flat</td>
<td>0</td>
<td>0</td>
<td>14 %</td>
<td>34 %</td>
</tr>
<tr>
<td>Polipoid</td>
<td>19 %</td>
<td>21 %</td>
<td>32 %</td>
<td>78 %</td>
</tr>
<tr>
<td>Mucosal thickening &gt;80%</td>
<td>12 %</td>
<td>9 %</td>
<td>34 %</td>
<td>56 %</td>
</tr>
<tr>
<td>Air-fluid level</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>31 %</td>
</tr>
</tbody>
</table>

As to the maxillary dental component, 28% of the patients missed some permanent teeth, of majority being the lateral incisors (23%). Also, 9% of the patients had supernumerary teeth.
Main findings in the mandible were agenesis and other dental problems. As to other findings, 5% of patients displayed a striking size difference between the left and right ramus. For both maxilla and mandible, periapical and periodontal problems only concerned patients older than 14 years of age.

Fig. 1. CBCT images (axial, coronal and sagittal) evidencing pansinusitis involving the sphenoid, ethmoid, and maxillary sinuses

Fig. 2. CBCT (axial and coronal) images showing nasal septum deviation
Table 2. Dental findings in maxilla and mandible

<table>
<thead>
<tr>
<th></th>
<th>Maxilla</th>
<th>Mandible</th>
</tr>
</thead>
<tbody>
<tr>
<td>Localized periodontal disease</td>
<td>34%</td>
<td>31%</td>
</tr>
<tr>
<td>Generalized periodontal disease</td>
<td>12%</td>
<td>15%</td>
</tr>
<tr>
<td>Periapical lesion</td>
<td>10%</td>
<td>12%</td>
</tr>
<tr>
<td>Impaction incisors</td>
<td>7%</td>
<td>3%</td>
</tr>
<tr>
<td>Impaction canines</td>
<td>33%</td>
<td>14%</td>
</tr>
<tr>
<td>Impaction premolars</td>
<td>11%</td>
<td>9%</td>
</tr>
<tr>
<td>Missing lateral incisors</td>
<td>23%</td>
<td>17%</td>
</tr>
<tr>
<td>Missing central incisors</td>
<td>3%</td>
<td>5%</td>
</tr>
<tr>
<td>Missing premolars</td>
<td>2%</td>
<td>4%</td>
</tr>
<tr>
<td>Supernumerary</td>
<td>9%</td>
<td>7%</td>
</tr>
<tr>
<td>Caries</td>
<td>56%</td>
<td>67%</td>
</tr>
<tr>
<td>Shape anomalies</td>
<td>32%</td>
<td>45%</td>
</tr>
</tbody>
</table>

4. DISCUSSION

The current study focused on identifying all anomalies within the complete FOV in young CLP patients. The total ratio of incidental findings on CBCTs in CLP patients was 90.1%; these findings included anatomical, as well as pathological variations. A high percentage has been also registered in other studies, performed on non-cleft populations [9-12].

As already mentioned, the most frequent findings appeared in the airways (paranasal sinuses and nose), which is quite normal, if considering the ENT problems and the deviating anatomy in CLP patients.

Otitis media and opacification of the mastoid is a relevant clinical finding, agreeing with the study of Timmerman et al. [2], who found a 13% incidence of otitis media with effusion in a group of 10-15 year-old CP patients, in contrast to a much higher incidence at younger ages. Flynn et al. [4] mentioned an even higher percentage of middle ear problems (21–32%) in this age group, stating the importance of follow-up for these patients. Thus, when making a CBCT in CLP patients, special attention has to be paid to this region, in order to timely refer CLP patients to the ENT specialist.

The mean percentage of findings concerning the sinuses was of 78.1%. Other studies mention a similar high percentage of sinus findings in a non-cleft population [9-11,13,12-15]. Even if the results for sinus findings in younger non-cleft populations show a large variety, 14.3% in Cha et al. [16] versus 46.8% in Pazera et al. [17], the ratio registered in our CLP group may indicate that sinus findings in this younger age group are more common in a CLP population, due to altered anatomy, especially nasal septum deviations. Generally, the observed sinus pathology is usually asymptomatic [14] and, in most of the cases, referral to an ENT specialist is not always necessary, which is also valid for CLP patients.

In the group of CLP patients here analyzed, nasal septum deviation was present in 93% of the cases. The percentages mentioned in other studies range between 0.1 and 56.7% but, usually, they concern older patients [11,12,16,18-20]. One study indicates that nasal septum deviation may increase with age [20].

As expected, most of our findings in the maxillary and mandibular region concerned teeth. Also, similarly with other studies, there were more missing teeth, especially lateral incisors, more impacted and supernumerary teeth than in a noncleft population [10,6-8]. Knowledge about missing teeth is important for planning the orthodontic treatment, and should be taken into account for planning the bone graft procedure. However, there is no indication to make a CBCT scan only for these reasons as,
usually, these findings can be also diagnosed on 2D radiographs.

Due to the multidisciplinary nature of these patients, the specialists from the CLP team should systematically read the CBCT, according to a standardized protocol. Our findings show that, in CLP patients, an extended FOV may have added value, as the diagnostic information made available may be also useful for other specialists concerned with the treatment.

5. CONCLUSIONS

The CBCT findings are related to CLP problems, such as middle ear and mastoid problems, agenesis of teeth, supernumerary and impacted teeth. Some of the incidental findings show that specific background knowledge on cleft-related problems and effects of the CLP treatment is necessary for an adequate diagnosis. Thus, CBCT scan in patients with clefts asks for careful and thorough interpretation and participation of a multidisciplinary team.

References