Journal of Cranio-Maxillo-Facial Surgery 44 (2016) 1373–1380

Contents lists available at ScienceDirect

Journal of Cranio-Maxillo-Facial Surgery

journal homepage: www.jcmfs.com

Incidence and frequency of nondental incidental findings on cone-beam computed tomography

Benjamin Togan[*], Thomas Gander, Martin Lanzer, Rücker Martin, Heinz-Theo Lübbers

Department of Oral and Maxillofacial Surgery, University of Zürich, Frauenklinikstrasse 24, 8091 Zürich, Switzerland

A R T I C L E I N F O

Article history:
Paper received 11 March 2016
Accepted 27 June 2016
Available online 5 July 2016

Keywords:
Cone-beam computed tomography
Diagnosis
Incidental finding
Radiology
Head and neck

A B S T R A C T

Purpose: The purpose of the present study was to determine the frequency of relevant nondental related incidental findings in cone-beam computed tomography (CBCT) of the head and neck.
Material and methods: Nine hundred ninety-nine images were retrospectively reviewed for incidental findings. Those were defined as carotid artery calcification (CAC), paranasal sinus findings (PSF), sialolithiasis of the parotid gland (SP) or submandibular gland (SSub), calcification of the ligamentum stylohyoideum (CLS), and Stafne bone cavity (SBC). All datasets obtained between 2010 and 2014 at a university-based school of dental medicine in Switzerland were reviewed. Demographic data such as age and sex were also recorded.
Results: A total of 350 incidental findings within the 999 CBCT scans were identified. The most frequent finding was PSF (27.8%), followed by CLS (11.6%), CAC (5.3%), and SSub (0.8%). No SP or SBC was found. Incidental findings were most frequent between 61 and 70 years of age. Males had a higher prevalence in CAC, PSF, and SSub than females.
Conclusions: These results underscore the need for a complete examination of every CBCT image beyond the region of interest.

1. Introduction

Diagnostic imaging of the maxillofacial region substantially improved with the development of cone-beam computed tomography (CBCT). In 1995, Italian coinventors Attilio Tacconi and Piero Mozzo first used this technology in dentistry (Scarfe et al., 2012). In 1999, the NewTom DVT 9000 (QR, Inc., Verona, Italy) was the first commercial CBCT unit to be introduced in Europe (Scarfe et al., 2012).

Since that time, CBCT has become of essential use in dentistry and maxillofacial surgery because of its functionality, which is different from that of medical computed tomography (CT). As the name implies, the beam is cone shaped, which allows the operator to capture a large field of view (FOV). To capture the same FOV in a medical CT scan, in which the beam is fan shaped, the patient has to be scanned in a linear translation movement (Angelopoulos et al., 2012). CBCT provides values that allow visualisation and differentiation between air, water, and soft tissue to a limited extent (Yamashina et al., 2008).

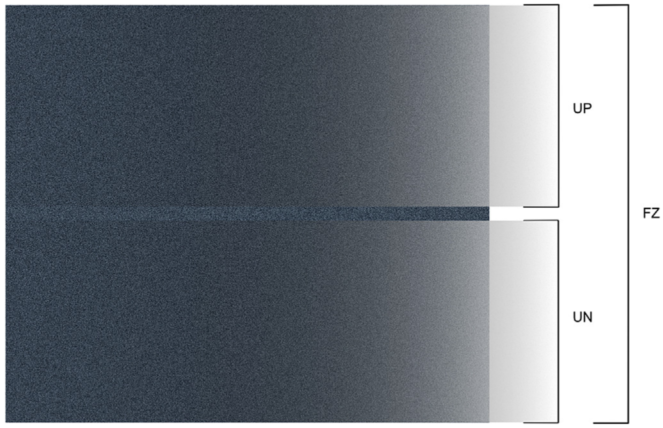
Another advantage of CBCT is its low-dose radiation, compared to medical CT. In a medium FOV (10–15 cm) the effective radiation dose from a multislice computer tomography (MSCT) scan with 0.6 mm voxel size is 1.5–12.3 times greater than that of a CBCT scan with 0.15–0.4 mm voxel size (Ludlow and Ivanovic, 2008). However, the radiation dose is greater in CBCT scans than in panoramic radiography. In one study, the maximum effective doses of two CBCT units were 67 times and 21 times greater than panoramic radiography, respectively (Shin et al., 2014). Despite this, most dental practices use CBCT to image nearly every area of the maxillofacial region, including dentoalveolar dentistry, maxillofacial surgery, orthodontics, implantology, endodontics, periodontics, general dentistry, forensic dentistry, and otolaryngology (De Vos et al., 2009).

Three-dimensional (3-D) visualisation of a region of interest provides information that improves localisation of a pathology and diagnostic accuracy. Patients consequently enjoy better care and treatment outcomes and reduced treatment time and

* Corresponding author.
E-mail addresses: benjamin.togan@gmail.com (B. Togan), thomas.gander@usz.ch (T. Gander), martin.lanzer@usz.ch (M. Lanzer), martin.ruecker@usz.ch (R. Martin), t.luebbers@gmail.com (H.-T. Lübbers).

http://dx.doi.org/10.1016/j.jcms.2016.06.026
1010-5182/

Table 1
FOV.[a]



	Full size	Upper part	Under part	Total
Upper anatomical border	Horizontal line from highest point of sinus maxillaris	Horizontal line from highest point of sinus maxillaris	Horizontal line at point between the two incisors	
Under anatomical border	Horizontal line at C4-C5	Horizontal line at point between the two incisors	Horizontal line at C4-C5	
Number of datasets	442	230	327	999
CAC	X		X	769
PSF	X	X		672
SP	X	X	X	999
SSub	X		X	769
CSL	X		X	769
SC	X		X	769

The FOV[a] of our datasets from our database is different in every scan. For evaluation they were subdivided in full size (442 datasets), upper part (230 datasets) and under part (327 datasets). This table shows how many datasets were evaluated for each finding and in which FOV the findings can be detected.
[a] Field of View: FZ, full size. UP, upper part. UN, under part.

complications (Price et al., 2012). Nevertheless, CBCTs can also be used for a variety of indications, such as calcified anomalies (Lanzer et al., 2015), the anatomy of the retromolar canal (Filo et al., 2015), or for identifying and measuring the alveolar loop (Filo et al., 2014).

Not every practitioner has the skills and the knowledge to detect every pathology in a CBCT image, although a practitioner should be able to interpret a complete image. In addition to a region of primary interest, there could be other important findings that potentially concern a patient's health. Some incidental findings are frequently described in the literature: for example, mucosal thickening and the frequency of paranasal sinus cyst (Drage et al., 2013) or the frequency of carotid artery calcification (Price et al., 2012).

Determining the frequency of incidental findings can improve the knowledge of dental practitioners and allow such practitioners to initiate diagnostic interventions. Patients can be treated early by the right therapy to stop the progression of a disease.

The aim of this retrospective study is to determine the frequency of relevant incidental findings and the age and sex distribution in CBCT imaging. The five incidental findings investigated were carotid artery calcification (CAC), paranasal sinus findings (PSFs), sialolithiasis submandibularis/parotis (SSub/SP), calcification of the stylohyoid ligament (CSL), and Stafne bone cavity (SBC).

2. Material and methods

In this study, 999 CBCT datasets obtained between 2010 and 2014 were reviewed. All datasets were derived from the database of a school of dental medicine in Switzerland. The CBCT datasets were generated by a KaVo 3D eXam CBCT scanner (KaVo Dental GmbH, Biberach, Germany). The following standard settings were used for most datasets: a scan speed of 8.5 s; a rotation of approximately 360°; a voxel size of 0.4 mm; and an x-ray source of high-frequency, constant potential, 90–120 kVp, 3–8 mA (pulsed). The datasets were viewed with the eXam Vision program (KaVo Dental GmbH, Biberach, Germany). The CBCT unit is able to record datasets that vary in vertical dimension (i.e., only the cranial or the caudal part of the head for the primary indication). Thus, for the evaluation, the datasets were separated based on whether they involved the airway area (230 datasets), the cervical area (327 datasets), or both areas (442 datasets) (Table 1).

All 999 datasets were retrospectively reviewed for incidental findings, which were defined as carotid artery calcification (CAC), paranasal sinus findings (PSF), sialolithiasis parotis (SP) and submandibularis (SSub), calcification of ligamentum stylohyoideum (CLS), and stafne bone cavity (SBC). The criteria for identifying these findings are described in Table 2. The datasets were reviewed without provision of any information about the primary indication.

The first examination was executed by a qualified postgraduate with specialised knowledge. The second examination was executed by a qualified associate professor of oral and maxillofacial surgery who specializes in radiology. All provisional positive findings were reanalysed, and their correctness was confirmed or refuted by consensus. To avoid bias, the opinion of the examiner regarding calcification and the patients' medical and dental information were not revealed.

The findings in the predefined areas were checked for bilateralism or unilateralism. Demographic information such as age and sex were also recorded. All data related to the findings were subsequently registered in Excel (Microsoft, Redmond, WA, USA).