

Main incidental findings from cone beam computed tomography in the head and neck region and the impact in patients' lives: an integrative literature review

Principais achados incidentais em tomografia computadorizada de feixe cônico na região de cabeça e pescoço e o impacto na vida dos pacientes: uma revisão integrativa de literatura

Diego Leonardo de **SOUZA**¹  0000-0001-8455-936X

Mario Eduardo Escobar **RAMOS**¹  0000-0003-4112-2314

Márcio **CORRÊA**¹  0000-0002-9063-7974

ABSTRACT

To identify the main incidental findings (IFs) in the head and neck region using Cone-Beam Computed Tomography (CBCT) and the impact on patient's life. The study was carried out using an integrative review method, starting with a guiding question followed by searches in the databases Pubmed, Scopus, Virtual Health Library and Dentistry & Oral Sciences Source for articles from 2009 until 2019. Forty-one articles became the object of this work. The incidental findings most reported by the articles are present in the bone and TMJ regions, with 35 different AIs being found. However, they are also common in the airways, such as mucosal thickening and retention mucosal cysts. Among the dental, the most pointed are impacted and supernumerary teeth. In the group of soft tissue calcifications, tonsillolite and calcification of the hyoid-style process are the most frequent. Atheroma and malignant lesions are less prevalent, but important due to the impact on patient's life. The main incidental findings are bone / TMJ, followed by dental, soft tissue calcifications, airways and other findings. Most of them do not affect patient's life. However, some IFs require immediate interventions and are generally associated with elderly patients. Finally, more than half of the studies pointed out that the incidental findings are located in an extragnatic region.

Indexing terms: Incidental findings, Cone Beam Computed Tomography, Diagnostic imaging.

RESUMO

Identificar os principais achados incidentais na região de cabeça e pescoço com o uso de Tomografia Computadorizada de Feixe Cônico (TCFC) e os impactos na vida dos pacientes. O estudo foi realizado utilizando como método a revisão integrativa, iniciado com pergunta norteadora seguida de buscas nas bases de dados Pubmed, Scopus, Biblioteca Virtual em Saúde e Dentistry & Oral Sciences Source por trabalhos de 2009 até o ano de 2019. Tornaram-se objeto deste trabalho quarenta e um artigos. Os achados incidentais mais relatados

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¹ Universidade Federal de Santa Catarina, Centro de Ciências da Saúde, Departamento de Odontologia. Campus Universitário, 88040900, Trindade, Florianópolis, SC, Brasil. Correspondence to: DL Souza. E-mail: <diego.220v@hotmail.com>.

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pelos artigos estão presentes nas regiões ósseas e de ATM, sendo encontrados 35 diferentes AIs. No entanto, eles também são comuns em vias aéreas, como o espessamento de mucosa e cistos de retenção mucosa. Entre os dentários, os mais apontados são dentes impactados e supranumerários. Já no grupo das calcificações de tecidos moles, o tonsilólito e as calcificações do processo estilo-hióide são as mais frequentes. Ateromas e lesões malignas são achados com menor prevalência, mas importantes devido ao impacto na vida do paciente. Os principais achados incidentais são os ósseos/ATM, seguidos pelos dentários, as calcificações de tecidos moles, as das vias aéreas e outros achados. A maioria deles não afetam a vida do paciente. Porém, alguns AIs requerem intervenções imediatas e geralmente estão associadas a pacientes idosos. Por fim, mais da metade dos estudos apontaram que os achados incidentais estão localizados em região extragnática.

Termos de indexação: Achados incidentais, Tomografia Computadorizada de feixe cônico, Diagnóstico por imagem.

INTRODUCTION

With the advancement of technology, much has been developed in the radiology area, In this sense, we can say that the advent of CBCT has made the diagnosis faster and more accurate, giving the development of equipment and easy access to the exam [1]. In addition, it has been benefited for dentistry, because it provides excellent images analyzes information, mainly maxillofacial bone anatomy and teeth at a potentially lower radiation dose, lower cost for the patient compared to multi-detector computed tomography [2], and allows the professional to evaluate patients for a variety of illnesses [3].

With the evolution of CBCT devices, it became possible to obtain images of fields of view (FOV) of varying sizes. In light of this and combined with the quality of these exams, the responsibility of the dental surgeon (DC) and the radiologist has grown since there is a greater chance to find incidental findings (IFs), which are those whose discovery occurs by chance, that means, finds based on an examination carried out for another purpose [3]. Several authors point out that these discoveries can affect patients' lives in several ways with a consensus that tells: a careful and complete interpretation of the CBCT images is necessary beyond the region of interest to avoid neglecting diseases that are eventually not showing symptoms and that are discovered early as an IF [2].

After performing the imaging exam, it is up to the radiologist and the requester to complete the analysis of the entire volume of data, since a complete analysis allows the detection of IFs with significant or not clinical potential [2]. Ignoring part of the exam can be dangerous, since most IFs are extragnatic [4] and, therefore, outside the region of common interest of DCs. However, this does not exempt them from legal responsibility. Therefore, a better understanding of the IFs revealed by the CBCT images can help professionals to identify significant injuries. This article is an integrative review and aims to identify the main IFs in the head and neck region with the use of CBCT and the impact on patients' lives.

This research is an integrative literature review. The integrative review has six steps: 1) identification of the theme; 2) establishment criteria for inclusion and exclusion of studies/sampling or literature search; 3) definition of the information to be extracted from the selected studies/study customization; 4) evaluation of the studies included in the integrative review; 5) interpretation of results and 6) presentation of the review/synthesis of knowledge.

The research started with a guiding question, "What are the main IFs in CBCT in head and neck region and the impact on the patient's life?". Health Sciences and MeSH (Medical Subject Headings). The terms selected were: "Incidental findings", "Cone-beam computed tomography" and "Diagnostic imaging". Making the search keys, all terms and their synonyms in Portuguese, English, and Spanish were used. With the search strategy defined, Pubmed, Scopus, Dentistry and Oral Sciences Source, Virtual Health Library (VHL / Lilacs, BBO), and Scielo were consulted. The inclusion criteria defined for this research were: articles published between 2009 and 2019, written in Portuguese, English, or Spanish, regardless of the number of samples, which presented in the title, abstract, or body of the article at least two of the aforementioned terms. The exclusion criteria used were: articles that were not available in full free of charge, letters to the editor, editorials, and works not related to the area of dentistry. The research resulted in 265 papers, after reading titles, abstracts and applying the inclusion and exclusion criteria, 167 articles were discarded. After analysis and removal of duplicates, 41 studies became the object of this research. Figure 1 illustrates the selection process.

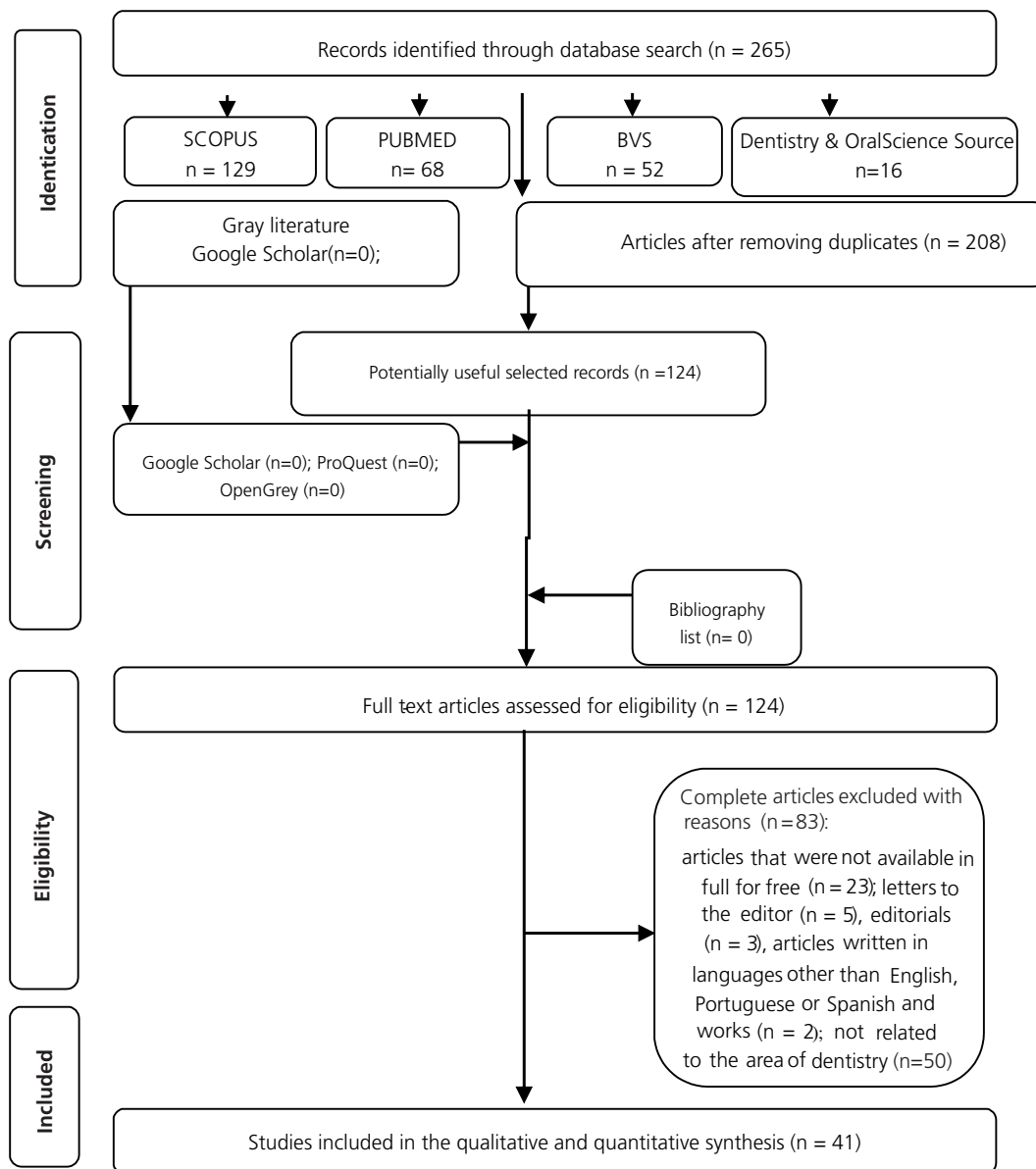


Figure 1. Synthesis of the selection of articles after searching, application of inclusion criteria, reading of titles and abstracts and elimination of repeated works, and reading of articles in full. (Adapted from PRISMA)

In possession of these articles, the studies were categorized. In this stage, the objective was to organize and summarize the information in a succinct aspect, forming a database of easy access and management [5]. In this way, extraction of information from the works was applied: year of publication, country of publication, name of the authors, type of study, quantity/number of the sample, and the main conclusions. From these data, the main themes reported by the authors were grouped, thus obtaining two major groups, namely: 1) CBCT and the main incidental findings and 2) The impact of IFs on patients' lives.

RESULTS

We highlight 101 incidental findings as the main ones, as they are the most reported in the articles that make up this review. We divided these AIs into 5 large groups, namely: 1 - airway findings, 2 - dental findings, 3 - soft tissue calcifications, 4 - bone and TMJ findings, and 5 - other findings.

Chart 1. Main incidental findings reported in the 41 articles that make up this integrative review and number of articles that report them (n).

Airways	Dentals	Bone/TMJ
<p>Mucosal thickening (18) Mucosal polyps (16) Deviated septum (14) Hypertrophic shells (4) Bubble shells (12) Mucous retention cysts (16) Sinusitis Signs (12) Signs of Pansinusitis (5) Oroantral fistula (3) Anthrolites (7) Hypertrophic Tonsils (6) Maxillary sinus hypoplasia (4) Maxillary sinus aplasia (2) Nasopalatine duct cyst (5)</p>	<p>Enamel Pearls (4) Supernumerary tooth (13) Supernumerary root (1) Impacted teeth (9) Periapical lesion (6) Sclerosis and periapical rarefaction (1) Root fracture (2) Dentigerous cyst (5) Residual cyst (2) Odontoma (6) Macrodonitics (1) Fusion (2) Hypodontia (2) Microdonitia (2) Twining (2) Root tearing (4) Root shortening (2) Ectopic position (1) Other odontogenic cysts (2) Caries (2) Vestibular bifurcation cyst (1) Internal resorption (2) External resorption (6) Claw cusp (1) Bullfighting (2) Dens in tooth (3) Bone loss (1) increased periodontal ligament (3) Odontogenic keratocyst tumor (4) Lateral periodontal cyst (1) Cementoblastoma (2) Residual root (3) Ameloblastoma (2)</p>	<p>Vertebrae crack (1) Bifid mandible condyle (9) Mandibular condyle erosion (4) Osteophytes (12) Condensing osteitis (6) Periapical rarefied osteitis (7) Cemento-osseous dysplasia (5) Simple bone cyst (3) Idiopathic sclerosis (5) Palatine torus (3) Mandibular torus (4) Exostoses (3) Osteoma (5) Stafne bone defect (3) Condyle flattening (6) Subchondral sclerosis of the TMJ (3) TMJ erosion (3) Degeneration of vertebrae (3) Fibrous dysplasia (8) Fusion of vertebrae (5) Flattening of vertebrae (1) Osteoarthritis / cervical osteoarthritis (5) Rotation of vertebrae (1) Presence of ossicles in the vertebra (2) Vertebral Pontiac (3) Increased Turkish saddle (3) Condylar hypoplasia (6) Physiological remodeling of the TMJ (3) Vertebral pneumocysts (2) Empty Turkish saddle (1) Giant cell injury (3) Condylar hyperplasia (2) Navicular fossa (1) TMJ subondral pseudocyst (4) TMJ degeneration (5)</p>
<p>Soft tissue calcifications Sialolite (10) Calcification of the common carotid artery (11) Intracranial calcification of the internal carotid artery (5) Calcification of hyoid-style ligament (12) Tonsilloliths (14) Calcification of thyroid cartilage (4) critical cartilage (2) Calcification of Falx Cerebri (1) Calcification of the pineal gland (6) Lymph node calcification (6) Cutaneous osteoma (4) Calcification of paranasal sinus (2) Dental pulp calcification (2) Medial calcinosis of Mönckeberg (1) Calcification of interclimoid ligament (1)</p>		
<p>Other findings Foreign bodies (4) Intra-hemispheric lipoma (1) Notocordal cell tumor (1) Atheroma (3) Malignant Injuries * (3)</p>		

The literature points to the airway group as a commonplace to find IFs. In this sense, 14 IFs were detected in the articles, emphasizing the thickening of the mucosa, reported in 18 studies, followed by the mucous retention cyst described in 16, the mucous polyp also pointed out in 16 articles and the deviated septum expressed in 14.

In the group of dental findings, 33 different IFs were registered in the 41 studies evaluated, with emphasis on the supernumerary teeth, mentioned in 13 studies, the impacted teeth described in 9 articles, and the enamel pearls in 4.

In the third group, which concerns soft tissue calcifications, tonsillitis reported in 14 articles stand out, calcification of the style-hyoid process in 12, calcifications of the common carotid artery that were expressed in 11 articles, the pineal gland is calcified in 6 and the intracranial calcification of the carotid artery, which was mentioned in 5 studies.

The group of bone / TMJ findings was the one that most presented IFs, with 35 findings. The osteophytes described in 12 articles stand out, the condyle of the bifid mandible in 9 articles, fibrous dysplasia in 8, and degenerative changes in 3 studies.

Finally, in the fifth group, called "other findings", foreign bodies were more frequently identified in 4 studies, atheroma in 3 and malignant lesions also in 3. Chart 1 describes all the incidental findings, as well as the number of articles that have been reported.

Investigating the literature, we also noticed that the number of incidental extragnatic findings is high, totaling 68 IFs outside the region of interest to dental surgeons. On the other hand, 33 findings in the dental region were highlighted. This demonstrates the need to evaluate cone-beam tomography in its entire volume. Figure 2 describes the number of incidental findings and the regions in which they were found.

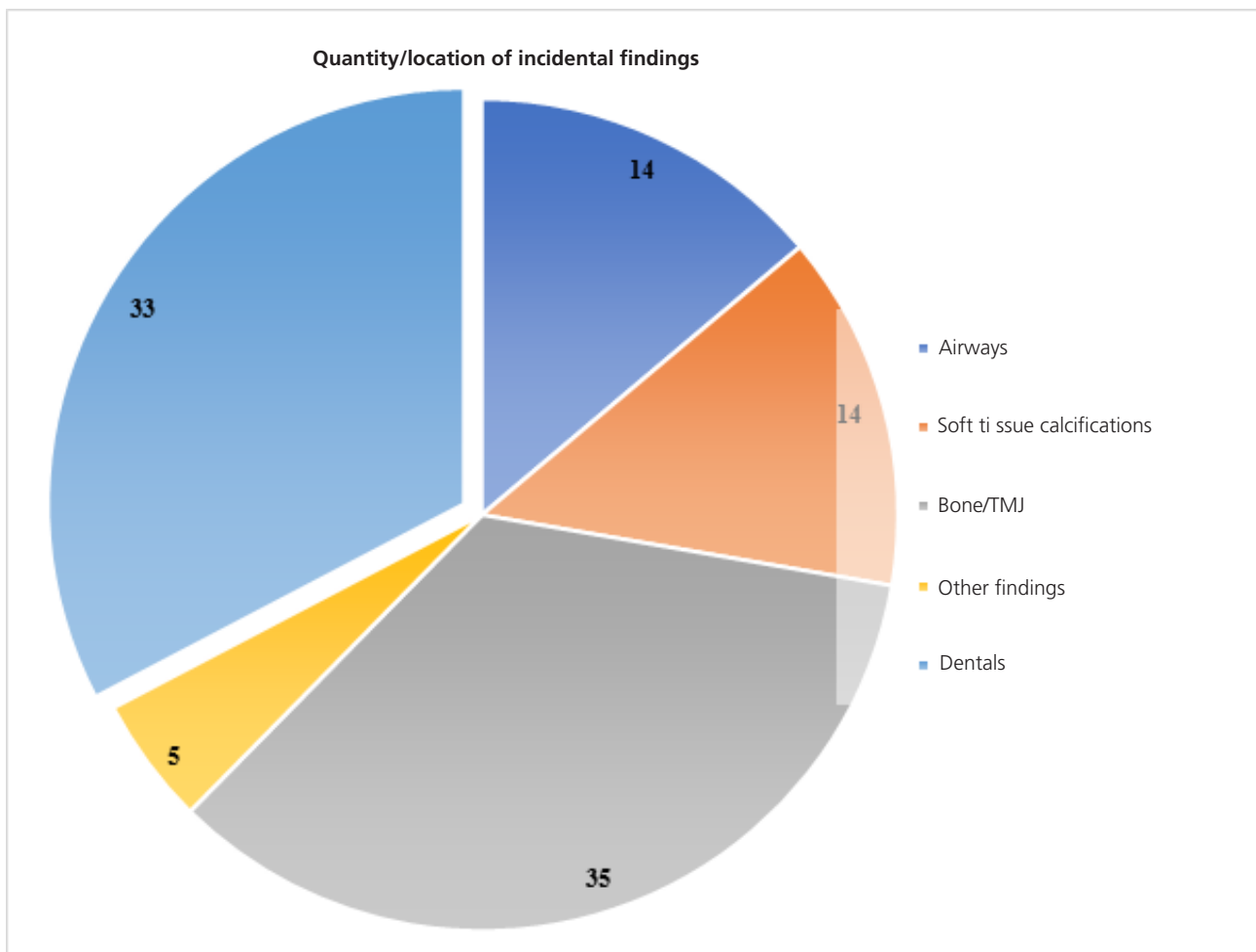


Figure 2. Description of the quantity and location of the main incidental findings reported in the 41 articles surveyed.

DISCUSSION

CBCT and main incidental findings

CBCT images were well received in the dental community and became an instrument in the planning and management of patients. However, with the greater use of this technology, there was also an increase in the number of IFs. Allareddy et al. [6], Carter et al. [7], and Horner et al. [8] warn that although often overlooked, the evaluation of all structures included in the examination is necessary according to the guidelines of the American and European Academies of Dentomaxillofacial Radiology. Furthermore, professionals should not only look at the area of interest, as they need to minimize the risk of neglecting hidden pathologies. The correct thing is to examine all the data in a systematic and regulated way [9].

It can be stated that one of the main parts of the tomography exam is the report. When faced with IFs, these should appear in the CBCT report. However, the inability to identify, inform or provide monitoring and care related to IFs can have adverse consequences for the patient and result in dentists neglecting their legal responsibility [4,10].

Several studies indicate that IFs in several areas are prevalent. For example, in Pazera et al. [11], three types of UA were diagnosed: thickening of the mucosa (23.7%), polypoid thickening of the mucosa (19.4%), and signs of acute sinusitis (3.6%). In the works by Rogers et al. [12]. Als in the area of the airways included thickening of the mucosa (21.3%), deviation of the nasal septum (12.6%), concha hypertrophy (11.1%), bullous shell (3.9%) and retention cysts (2.9%).

Identifying an IF can save, but it can also lead to distress if the patient has not been warned that IFs may arise [13]. Togan et al. [14] complement by highlighting that patients can be treated early by the right therapy to stop the progression of a disease.

The findings that require immediate interventions are soft tissue calcifications, such as arteries and ligaments, as there is a strong relationship between carotid artery calcification and risks for stroke [15-17]. Several studies were carried out to verify soft tissue calcifications, such as the one by Andò et al. [18], Zain-Alabdeen et al. [19] e Khojastepour et al. [20]. The study by Silveira et al. [21], described that extracranial calcifications were found in 136 patients (33.5%) of the 406 patients in their study. These more important IFs are expected in older patients. Even though most IFs are not lethal, they should not be ignored. Another important AI is Mönckeberg's medial calcinosis, which can indicate kidney, heart problems, and diabetes. Unlike atherosclerosis, Mönckeberg's medial calcinosis does not obstruct the vessel lumen. However, their elasticity and compliance decrease with a possible reduction of perfusion and clinically relevant coronary and peripheral arterial disease [18], their early discovery may prevent limb amputations. However, most IFs do not require treatment or referral to another professional [10].

The literature demonstrates that these IFs have a varied frequency [19]. However, most of these findings do not cause serious harm to patients, however, an examination should not be neglected. The study by Khojastepour and collaborators [20] concluded that all images of CBCTs need to be reviewed comprehensively, since their study, 475 of 773 individuals had at least one AI, with an overall rate of these findings of 60%. This is in line with the study by Çaglayan and Tozoglu [3], which showed that the frequency of incidental findings was 92.8% in 207 patients. These discrepancies may be due to variations in age groups, patient characteristics, ethnicity, socioeconomic aspects, and anatomical groupings [19].

Note that the largest number of AIs occurs in areas where the DC is not commonly familiar. This means that some AIs may go unnoticed, such as calcifications of the hyoid-style process, which may suggest Eagle's syndrome. However, tonsilloliths, although not serious, can cause daily problems such as decreased social interaction due to halitosis. In these cases, where the AI can be harmful to the patient, referral to other professionals is necessary.

Most of the authors have dedicated themselves to researching AIs and their impacts. The findings that require immediate interventions are soft tissue calcifications, as reported by Faxon et al. [15] when highlighting that there is

evidence about the strong association between intracranial artery calcification and carotid artery stenosis, with better defined vascular risk factors for stroke (stroke). An association was also found between the presence of calcifications in any artery and a three to four times greater risk of cardiovascular events and death. It is even known that in the context of atherosclerosis, carotid artery disease identifies patients with a higher risk of fatal and non-fatal myocardial infarction and stroke [15].

Although they are frequent, it is not yet known what the precise incidence of IFs is in the literature [19]. However, most of them do not appear to cause harm to patients and, therefore, do not require any intervention [10]. Finally, the low number of IFs that threaten patients' lives emphasizes that CBCT should not be considered a replacement for ordinary radiographs, given that its radiation dose is higher when compared to two-dimensional radiographs and its cost is high, but if it is used, all areas of the scan must be evaluated by an experienced radiologist or dentist [22].

Impact of IFs on patient's lives

IFs can be due to several factors, such as allergies, anatomical variations, or even the first signs of serious diseases [15,23]. Underdiagnosis can be of concern since not identifying or ignoring an IF can cause harm to the patient. Not infrequently, the CD is the first professional to find signs of diseases whose health directly reflects on the individual's life, such as calcifications of the carotid artery, which several studies indicate as a stroke and stroke predictor. The discovery of these IFs can help the professional to recognize significant entities and, at the same time, reduce the patient's exposure to other unnecessary exams, which can cause economic, psychological, and physical consequences [19,24].

The impacts on patients' lives can occur due to three factors, which are: the correct diagnosis, clear and transparent information, and the early detection of potentially serious AIs. Knowing them helps the clinician in the management of each case, as well as making treatment faster and more efficient, less costly, and protecting the lives of patients.

Diagnostic accuracy is the key to preventing further harm to patients. A properly observed AI eliminates further investigation of potentially harmless entities. The overestimated diagnosis can give the patient the impression of being in danger and make him go through situations of stress and unnecessary torment. Authors such as Do ramac and collaborators [24] and Husain et al. [25] affirm that the differentiation between important and non-clinical findings reduces referrals to other complementary exams, such as biopsies. However, underdiagnosis is also dangerous. The dentist who requests CBCT exams for his patient should examine them for IFs for the benefit of the patient's health, ensuring that an efficient procedure is performed [22].

In the studied literature, there is a duality in terms of informing or not patients about all the IFs found in the exams. At one end, there are those who argue that findings that do not interfere with health and well-being should be omitted and others who say that the patient has the right to know everything that was found in his CBCT. Welch and colleagues [26], ratify this dilemma by pointing out that on the one hand, there is the concept that too much information is potentially harmful and that the patient would be better off without knowing all the AIs. On the other hand, the Council of the American Medical Association on Ethical and Judicial Affairs [27], says that professionals have an ethical and legal duty to disclose all relevant information to patients. Scarfe [28] adds by stating that the patient's "right to know" outweighs all other professional considerations and that, ultimately, it is up to the patient to decide how much risk he himself must tolerate.

Seeking a consensus in this area, what should be done is to dialogue with the patient, explaining the possible IFs that can be found in the area where the exam is performed, seeking to exhaust all the patient's doubts. The conceptualized consent process includes a discussion of whether and how the patient wishes to be informed of any clinically significant findings that may require further studies or interventions to ensure their health and well-being [29]. When dentists anticipate these possibilities and communicate with their patients in this shared decision-making process, AIs are likely to be managed in a manner that satisfactorily meets the patient's wishes [29]. In this sense, it is necessary to resolve doubts about the CBCT and the IFs, managing these findings in the best possible way.

CONCLUSION

The main IFs found in the bone / TMJ region, were 35 entities, on which the most frequent were the bifid mandibular condyle and fibrous dysplasia. Then the dental region, where 33 IFs were found, on which the most frequent were the supernumerary teeth and impacted teeth. The airway region and soft tissue calcifications showed 14 IFs each. In the first, mucosa thickening and mucosal retention cysts stand out. In soft tissue calcifications, on the other hand, tonsillitis and hyoid-style ligament calcifications were the most reported. Finally, in the group of other findings, 5 different IFs were found.

These IFs have variable frequencies due to several factors. Most of them do not affect the patient's life. However, a small portion requires immediate intervention, such as soft tissue calcifications, which are generally associated with older patients and are closely linked to cardiovascular diseases. Finally, more than half of the studies pointed out that the IFs are located in an extragnathic region. Therefore, it is necessary to evaluate the entire volume of data from the CBCT exam.

Collaborators

DL Souza participated in the design of the research question, creation of search keys, execution of the methodology, data evaluation, and textual writing. ME Escobar assisted in the design of the research question, creation and execution of the search keys, execution of the methodology, data evaluation, and textual supervision. M Côrrea made efforts in the design of the research question, supervision in the execution of the methodology, evaluation of the data, and supervision and textual correction.

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Number	Year and country	Author	Kind of study	Sample	Main conclusions
1	2011, Switzerland	Pazera et al.	Retrospective description	139 CBCT	In 46.8% of the sample, AIs were identified, most of them in the airways
2	2011, Wales	Rogers et al.	Case report	4 CBCT	Highlights the need for the entire volume of CBCTs to be retaliated by trained professionals.
3	2012, Turkey	Çağlayan & Tozoğlu	Clinical Trial	207 patients	In 92% of the sample, AIs were found, most of them in the airways; Radiologists should assess the images comprehensively .
4	2011, USA	Price et al.	Retrospective description	300 CBCT	AIs are frequent in CBCT exams; Careful and complete interpretation of images is required beyond the region of interest to avoid neglect of hidden pathologies.
5	2012, Japan and USA	Enciso et al.	Retrospective description	53 patients	Patients with obstructive sleep apnea (OSA) have a higher% of AIs in the region of the airways compared to patients without OSA.
6	2013, USA	Almong et al.	Case report	1 patient	Calcifications in the carotid artery can be visualized on CBCT; Need for referral to an appropriate professional for further investigation.
7	2013, USA	Edwards et al.	Systematic review	5 Articles	AIs are frequent in CBCT images and vary in terms of frequency and nature; Most are extragnatic findings; The effect of these AIs in terms of the requirement for follow-up care, intervention and the potential expense of subsequent treatment requires further investigation.
8	2013, USA	Barghan et al.	Case report	2 patients	Skeletal and soft tissue pathologies can be detected in CBCT; CBCT exams should be analyzed in full volume by an experienced professional, especially when using a large FOV.
9	2014, USA	Mahdian et al.	Retrospective description	30 CBCT	CBCT was more effective in diagnosing the extension, pattern, and location of the hyoid-style ligaments compared to panoramic radiographs.
10	2014, Canada	Edwards et al.	Retrospective description	427 CBCT reports and medical records	High occurrence of AIs in CBCT with large FOVs in an orthodontic population. (83.4%); Most of the AIs in an extragnatic region; Need for a comprehensive review of the entire volume of data, regardless of the area of interest.
11	2014, England	Doğramacı et al.	Retrospective description	183 CBCT	In 83% of the sample, AIs were found; Most of these findings in exams with small FOV focused on impacted canine teeth required little immediate intervention (0.3%). 28% of the sample needed follow-up.
12	2013, Netherlands	Kuijpers et al.	Retrospective description	284 CBCT	High frequency of AIs (95.1%); The prevalence of incidental findings is three times higher in patients with cleft lip and palate (CLP) compared to healthy patients; Many of the findings are related to problems arising from the CLP, so the examination of CBCT in patients with cleft requires careful and thorough interpretation by specialists.
13	2012, Not informed	Steier et al.	Case report	1 patient	It is important that CBCT scans are interpreted by properly trained and experienced radiologists or dentists in order to provide maximum benefit to the patient.
14	2014, USA	Miles, Danforth	Systematic review	Uninformed	Importance of making reports that point out the AIs, because based on them, patients can make decisions about their health, since they will have all the information about the findings.
15	2015, USA	Husain et al.	Case report	4 patients	Intervertebral pneumocysts can be detected as AIs in CBCT; Familiarity with the demographic and radiographic characteristics of this lesion is important for dentists and oral and maxillofacial radiologists to avoid unnecessary investigations of this benign and innocuous lesion and to avoid causing alarm to patients.
16	2015, USA	Newaz et al.	Case report	2 patients	Adequate diagnostic management required when incidental findings are discovered.
17	2015, Taiwan	Chen et al.	Retrospective description	500 CBCT	The prevalence of posticus dots (PP) can be assessed by CBCT. The imaging findings show the largest articular facet of the upper atlas (FAAS) on the PP side and the largest left-right difference in the FAAS area in patients with unilateral PP.

Appendix

Number	Year and country	Author	Kind of study	Sample	Main conclusions
18	2015, Canada	Edwards et al.	Retrospective description	18 CBCT	He concluded that among the evaluators considered experienced in CBCT, the agreement on the diagnosis of Als was "fair to good", whereas the intra-evaluator agreement was "excellent".
19	2016, Switzerland	Togan et al.	Retrospective description	999 CBCT	Fully analyze the entire volume of the exam; Dentists should be aware of the frequency and location of these findings and investigate further the clinically important ones beyond the region of main interest; Relevant incidental findings should be mentioned to students and included in dentist education in order to improve awareness for clear assessment and identification in all CBCT images.
20	2018, USA	Frazier et al.	Case report	1 patient	Mönckeberg's medial calcinosis is a form of arteriosclerosis is a benign condition that most commonly affects the facial arteries and is usually an incidental radiographic finding. The importance of its recognition is to alert the clinician about possible serious underlying systemic diseases, especially diabetes and chronic kidney disease.
21	2017, Brazil	Lopes et al.	Retrospective description	150 CBCT	Als were found in 92% of the studied samples; Most incidental findings do not require treatment or referral; The entire volume of the imaging exam must be assessed.
22	2017, USA	Oser et al.	Retrospective description	203 CBCT	The study demonstrated that a radiologist is significantly more likely to report incidental findings of CBCT with small FOV than in a resident in endodontics; Based on the high percentage of findings that were not noticed, we recommend that dentists and doctors consider that small FOV CBCT be analyzed and reported by a trained radiologist. If this is not an option, it is important to have adequate training to read these specific checks; It is important to thoroughly review the entire volume on all vision plans, write down all findings in the patient's record, review the findings with the patient and refer him if incidental findings require additional treatment.
23	2017, Canada	Alsufyani et al.	Retrospective description	7.689 CBCT reports	Als in the cervical spine or in the Clivus are not common (9.5%), but they can be significant; several findings may be associated with an increased risk of subsequent neurological impairment due to spinal cord instability and invasion. As such, they must be recognized and interpreted, with the recognition of the potential need for additional radiographic investigation beyond what the CBCT can offer.
24	2017, USA	Albert & Mupparapu	Case report	1 patient	They proposed a classification for mesiodens; This classification would be a useful tool to guide the dentist or specialist towards proper treatment options and planning.
25	2019, Italy	Borghesi et al.	Retrospective description	1.328 CBCT	The study reported the incidence, morphology and gender relationship of three-root upper premolars (PMSTR); Improving our knowledge of the presence and characteristics of this anatomical variant can help to increase the success rates of root canal treatments.
26	2019, Turkey	Bayrak et al.	Retrospective description	573 CBCT	The CBCT imaging system is used as a common tool for dental diagnosis and treatment planning before and after surgical procedures and can be used to evaluate intracranial calcifications, as it allows the image of bone and calcified structures. An important point is that CBCT has significant limitations in the image of anatomical structures. Common CT scans are more accurate in the diagnosis of intracranial calcifications, being more sensitive, specific and superior in this regard.
27	2014, Iran	Shokri, A., et al.	Retrospective description	100 CBCT	Septication of paranasal sinuses were the most frequently found Als;
28	2015, India	Warhekar et al.	Retrospective description	795 CBCT	The most common findings incidentally diagnosed in CBCT were orofacial malignancies (1.4%) followed by pathologies of the maxillary sinuses. Although the oral radiologist makes the specialist aware of the incidental finding and assesses the possibility of an underlying disease, they must be confirmed based on histopathological findings.

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Number	Year and country	Author	Kind of study	Sample	Main conclusions
29	2016, Not informed	Damaskos et al.	Retrospective description	484 CBCT	The identification of certain anatomical landmarks allows the detection of AIs along the segments of the internal carotid artery, including the extracranial C1 and petrous intracranial (C2), lacerum (C3), cavernous (C4), clinoid (C5) and ophthalmological (C5) segments C6); In the studied cohort, the frequency of calcification increases in segments C1, C5 / C6 and C4; The severity of calcification increases with increasing age, especially in segments C1, C4 and C5 / C6, regardless of gender; These findings would help to identify the extent of atherosclerotic burden in dental patients, who should be referred for evaluation, both for the presence of intracranial stenosis and white matter lesions.
30	2016, Brazil and Greece	Silveira et al.	Retrospective description	406 CBCT	Equal distribution of incidental representation of extra and intracranial soft tissue calcifications over the course of the ICA between 2 different populations aged ≥ 40 years from 2 different continents; Increasing age was clearly a predisposing factor in the presence of these calcifications; This should alert dentists to the need for additional evaluation by their patients by specialized doctors about the importance of these findings, because their presence is defined as a vascular risk factor for stroke.
31	2017, Spain	Ata-ali et al.	Systematic review	23 articles	There is no consensus on the cut-off point beyond which the thickening of the maxillary sinus mucosa should be considered pathological, and the definition of maxillary sinusitis also varies widely in the scientific literature. In this sense, an international consensus is needed in relation to these concepts, with a clear distinction between healthy and sick maxillary sinuses, in order to facilitate comparisons between studies.
32	2017, Saudi Arabia	Zain-alabdeen & Khateeb	Retrospective description	150 CBCT	Confirms the high prevalence of accidental maxillofacial findings in CBCT exams (92.2%); This result emphasizes the need to thoroughly examine CBCT volumes for clinically significant results, not only within the region of interest, but beyond. This approach benefits the patient and protects the professional.
33	2019, USA	Dief et al.	Systematic review	10 articles	It contributes to the importance of complete CBCT readings and the value of proper diagnosis of AIs; Although CBCT has been shown to be useful in dentistry, particularly in reference to the indication of dental implants and other indications, CBCT should be used as a secondary radiographic tool, with conventional radiographs remaining as the first option; although CBCT scans can improve treatment planning, there are more responsibilities associated with AIs in CBCT scans compared to conventional radiographs, especially since CBCT scans can cover areas that dentists may not be familiar with.
34	2017, Saudi Arabia	Al-Zoubi et al.	Retrospective description	412 CBCT	The prevalence of incidental pathologies of the maxillary sinuses is higher in asymptomatic patients seen at dental clinics. Therefore, dentists should be aware of these incidental abnormalities seen in the maxillary sinus. A thorough analysis of the entire CBCT scan helps professionals to accurately diagnose and make timely referrals, comprehensive treatment planning and follow-up.
35	2018, Brazil	Missias et al.	Retrospective description	1.000 CBCT	A high prevalence of soft tissue calcification was detected in CBCT exams with different sizes of FOV (62.6%). Although most cases do not require treatment or referral to another professional, they emphasized the importance of a thorough evaluation of imaging tests and the great contribution of CBCT to the diagnosis of soft tissue calcifications.
36	2018, Hong Kong	Kawai et al.	Retrospective description	169 CBCT	Radiodensities in the maxillary sinus were observed in 16.6% of asymptomatic patients; Periodontal pathology in the posterior maxilla seems to be an influencing factor in the presence of sinus radiodensities; Age and morphological changes in the sinus mucosa seem to be influencing factors in the shape of the radiodensities.

Appendix

Number	Year and country	Author	Kind of study	Sample	Main conclusions
37	2017, Brazil	Flaiban et al.	Retrospective description	202 CBCT	The prevalence of incidental findings in CBCT performed for orthodontic purposes is high (227 Als in 202 CBCT); The entire volume of the exam must be analyzed.
38	2019, Brazil	Oliveira et al.	Retrospective description	175 CBCT	Although no significant difference was observed in relation to the age and side of the face observed, or the prevalence and total number of each of the incidental findings, he observed that some changes are more likely to be observed bilaterally.
39	2012, USA	Allareddy et al.	Retrospective description	1.000 CBCT	In 94.3% of the examinations, Als were found. From the wide and comprehensive scope of discoveries found inside and outside the main areas of interest of the 1000 subjects, it can be concluded that it is essential that a person trained in advanced techniques of interpretation in radiology interprets the CBCT images. It can also be concluded that these CBCT images need to be reviewed comprehensively.
40	2012, USA	Pette et al.	Retrospective description	318 CBCT	The findings of this study suggest that there are many significant pathological findings unrelated to dentistry that can be detected by cone beam computed tomography (CBCT) with a wide field of view. Additional investigations should be carried out to determine the sensitivity and specificity of these radiological findings in relation to their true medical pathological diagnoses and relevance; It is not known whether CBCT scans will be a valuable screening tool for common systemic conditions such as cardiovascular disease, sinusitis and osteoarthritis or whether many false positive results will be detected, resulting in unnecessary medical examinations.
41	2016, USA	Syed & Mupparapu	Case report	4 Patients	CBCT is a relatively new technology in dentistry; As the CBCT findings include areas at the base of the skull that are not primarily intended for analysis, oral and maxillofacial radiologists have an obligation to identify, review and report anatomical variations of the skull base and prevent the initiation of other unnecessary images by dentists . The navicular fossa is one of those anatomical variations that affect the basioccipital and is similar to canalis basilaris medianus, which also affects the basioccipital.

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