Accessibility to the knowledge on anatomical variations from dentomaxillofacial CBCT

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Abstract

Objective: to investigate the accessibility of open access article on anatomical variations described on cone beam computed tomography (CBCT) using PubMed database. We wanted to investigate how many journals are sharing articles without pay-wall and how many are sharing articles without author publication charges.

Material and methods: a search equation was designed with exclusion criteria limiting the search in PubMed to articles published in English and French. The search was performed by one observer. We had found 2228 articles; among them 709 were accessible as 'full text'. After applying exclusion criteria and after full text reading only 50 articles remained for the review.

Results: the 50 selected articles shared 306 annotated (visual marking, explanation like arrows) and 432 not annotated figures with the public. The 76% of articles were single studies on one specific topic. The main topic was endodontics with 22 articles. 28 journals from all continents participated in the effort of sharing of figures on anatomical variations from CBCT. However, only 2 journals were completely free of charges for authors and readers.

Conclusions: we have found only 15 annotated and 3 not annotated figures in 2 articles published in 2 different open access journals (without reader pay-wall and without author publication charges). Sharing the knowledge on anatomical variations from dentomaxillofacial CBCT represents an exception in dental literature.

Keywords: open access, open science, anatomical variations, CBCT

Introduction

One of most important European recommendations for the good practical use of cone beam computed tomography (CBCT) in dentomaxillofacial radiology based on conclusions from European project SedentexCT from 2011 (http://www.sedentexct.eu/), is that a clinician (dentist, maxillofacial surgeon) is responsible of all of the CBCT field of view. Therefore, the sound knowledge of radiological anatomy, including anatomical variations, and of radiological signs of diseases from dentomaxillofacial area on CBCT examination should represent new skills to acquire by general and specialized practitioners.

Incidental findings and anatomical variations [1] should be of interest for dentists using CBCT in daily practice [2, 3]. Multiple retrospective studies on incidental findings on CBCT [4, 5] were already performed on diverse human populations such as in Germany (1029 CBCT) [6], United States (between 200 and 1000 CBCT depending of a study) [7-11], Canada (427 CBCT [12] and 7689 CBCT specifically about clivus and cervical spine [13]), Brazil (150 CBCT) [5-14], Switzerland (999 CBCT) [15], India (201 CBCT of maxillary sinus) [16], Iran (198 CBCT of maxillary sinuses) [17], Turkey (207 CBCT) [18], and South Korea (500 CBCT) [19].

All these studies shown different frequencies of anatomical variations and incidental findings depending of a given population. These studies emphasized on the major role of education of dentist in recognition of incidental findings and of anatomical variations, and on dentist responsibility in verifying all the CBCT field of view.

Education and self-education of general and specialized dentists on anatomical variations found in CBCT examination is based on the accessibility to the reference articles and annotated figures from freely accessible major database such as PubMed.

Currently many articles are hidden behind pay-walls and their access is limited. Therefore, we hypothesized that there should exist a major lack of free and accessible articles and of figures showing and explaining anatomical variations from CBCT because of current predominant economical model of scientifical publication.

We wanted to know in the present study how many figures were shared with the public without payment and what were the types of anatomical variations described on CBCT and accessible for free from PubMed. We also wanted to analyze how many figures were annotated (with clear visual information e.g. arrows showing anatomical details, variations, diseases), and thus addressed to general public, and

how many figures were not annotated and addressed to specialized public. Finally, we wanted to know what kind of journals published free figures accessible for readers, and if the publication process was also free for authors.

Materials and methods

The search equation was peformed on PubMed database on 17.06.2019 by one observer. The search equation was as following: CBCT [All Fields] AND ("anatomy and histology"[Subheading] OR ("anatomy"[All Fields] AND "histology"[All Fields]) OR "anatomy and histology"[All Fields] OR "anatomy"[All Fields] OR "anatomy"[MeSH Terms]) 17.06.2019.
There was no time limit (from 1948), but in the practical terms dental CBCT related articles appeared from 1998 onwards. The selected languages were English and French. Exclusion criteria were: all articles out of the scope of the present study, articles not involving any description of anatomical findings from CBCT, in vitro studies, experimental studies, animal studies, studies in languages other than English and French. We also excluded articles with figures describing methods (i.e., measurements) and not describing anatomy or anatomical variations.
The selection was first performed on title and abstract then the selected articles were reed in full-text by one observer. We found a total of 2228 articles. Among 2228 articles there were 709 articles that were free full-text AND full-text (31.82%). After applying exclusion criteria and after a full-text review we found 50 articles corresponding to our search.
The search of information on journals publishing policies was performed on official web pages of journals (instructions for authors, copyrights licenses). We especially wanted to know about country of publisher, or publishing company behind the journal title, on open access policies, on the type of proposed license, on author publication charges, on fees at submission, on fees for evaluation, on fees for technical review, and on fees for printing version.

Results

The 50 selected articles shared 306 annotated and 432 not annotated figures with the public (Table 1). The 10 main areas of investigation included 1) endondontics: 22/50 (44%) articles, with 120/306 (39.21%) annotated, and 169/432 (39.12%) not annotated figures; 2) morphology of the maxilla: 6/50 articles (12%), with 4/306 (7.84%) annotated, and 32/432 (7.4%) not annotated figures; 3) morphology of the skull base: 5/50 articles (10%), with 23/306 (7.51%) annotated, and 24/432 (5.55%) not annotated figures; 4) bone diseases: 4/50 articles (8%), with 28/306 (9.15 %) annotated, and 12/432 (2.77%) not annotated figures; 5) morphology of cervical spine: 3/50 articles (6%), with 35/306 (11.43%) annotated, and 5/432 (1.15%) not annotated figures; 6) morphology of temporomandibular joint (TMJ): 3/50 (6%)

articles, with 8/306 (2.61%) annotated, and 79/432 (18.28%) not annotated figures; 7) mandible: 3/50 articles (6%), with 19/306 (6.2%) annotated, and 15/432 (3.47%) not annotated figures; 8) orthodontics: 2/50 articles (4%), with 11/306 (3.59 %) annotated, and 65/432 (15.04%) not annotated figures; 9) dentomaxillofacial radiology (general): 1/50 articles (2%), with 16/306 (5.22%) annotated, and 13/432 (3%) not annotated figures; 10) periodontics: 1/50 articles (2%), with 3/306 (0.98%) annotated, and 3/432 (0.69%) not annotated figures.

The 38/50 (76%) articles are single studies on one specific topic. Only 3 topics (endodontic study on teeth 17 and 27, endodontic study on teeth 37 and 47, and description of variations of ponticulus posticus in C1 vertebra) are presented in 2 studies. Two topics (endodontic study on teeth 16 and 26, and one study on root fractures) are described in 3 studies. Number of figures with annotations vary from 1 to 31 per article, and without annotations from 1 to 69 per article.

Table 1. Sharing of figures and type of studied anatomical variations from CBCT.

Type of studies	Number of articles	Figures with annotation	Figures without annotation
Endodontics			
Teeth 41, 42 and 31, 32 [20]	1	2	3
Teeth 33 to 43 [21]	1	3	5
Teeth 34 and 44 [22]	1	2	2
Teeth 35 and 45 [23]	1	2	14
Teeth 34, 35 and 44, 45 [24]	1	5	35
Teeth 36, 37 and 46, 47 [25]	1	6	14
Teeth 37 and 47 [26, 27]	2	19	4
Teeth 36-38 and 46-48 [28]	1	3	4
Teeth 16-18 and 26-28 [29]	1	27	24
Teeth 16 and 26 [30-32]	3	5	7
Teeth 17 and 27 [33, 34]	2	4	3
Premolars maxilla and mandible [35]	1	6	5
Full mouth [36]	1	2	1
Root fracture [37-39]	3	24	34
Incisors [40]	1	4	12
Dens invaginatus [41]	1	6	2
Total endodontics	**22**	**120**	**169**
Maxilla			
Infraorbitary foramen [42]	1	4	2
Canalis sinuosum [43]	1	2	2
Greater palatine grooves	1	4	1

[44]			
Maxillary sinus [45]	1	9	12
Nasopalatine canal [46]	1	4	7
Maxillary sinus septa [47]	1	1	8
Total maxilla	**6**	**24**	**32**
Skull base			
Sphenoid sinus [48]	1	3	3
Pneumatisation of parapharyngeal space [49]	1	12	1
Foramen tympanicum or foramen of Huschke [50]	1	4	6
Pneumatization of the articular eminence [51]	1	1	5
Sphenooccipital synchondrosis [52]	1	3	9
Total skull base	**5**	**23**	**24**
Bone diseases			
Chronical renal failure [53]	1	3	4
Dentigerous cyst [54]	1	14	1
Eosinophilic granuloma [55]	1	4	1
Mixt mandibular lesions [56]	1	7	6
Total bone diseases	**4**	**28**	**12**
Cervical spine			
General [57]	1	4	1
Ponticulus posticus [58, 59]	2	31	4
Total cervical spine	**3**	**35**	**5**
Temporomandibular joint			
Idiopathic juvenile arthritis [60]	1	3	69
Idiopathic juvenile arthritis [61] (same authors group as [60])	1	2	9
General [62]	1	3	1
Total TMJ	**3**	**8**	**79**
Mandible			
Mental nerve loop [63]	1	3	10
Bifid mandibular canals	1	4	2

and retromolar foramina [64]			
Stafné bone cavities [65]	1	12	3
Total mandible	**3**	**19**	**15**
Orthodontics			
General [66]	1	5	24
Cleidocranial dysplasia [67]	1	6	41
Total orthodontics	**2**	**11**	**65**
Dentomaxillofacial radiology: general [68]	1	16	13
Periodontics (bone loss) [69]	1	3	3
Total	**50**	**306**	**432**

28 journals participated in the effort to free sharing figures on anatomical variations from CBCT (Table 2). All continents were involved. The countries the most involved were USA (5 journal titles), UK (3 journal titles), Brazil (3 journal titles), India (3 journal titles), and Iran (3 journal titles). There were from 1 to 7 articles (Dentomaxillofacial radiology) published in these 28 journals. There were 11 journals (20 articles) published by 11 major professional publishers.

Table 2. Journals sharing figures of anatomical variations from CBCT.

	Open access license	Author publication charges (APC)	Fees at submission	Fees for review	Fees for technical review	Printing fees
South America						
Brazil Dent J [20, 37, 41] (Brazil)	YES	No information	NO	NO	200-300 USD	No information
Braz Oral Res [21, 43] (Brazil)	YES, CC-BY	No information	NO	NO	No information	No information
J Appl Oral Sci [34] (Brazil)	YES, CC-BY	NO	NO	NO	NO	NO
North America						
Head Face Med [26, 45, 67] (BMC Editor) (Springer Nature) (USA)	YES, CC-BY	2490 USD plus VAT	NO	NO	NO	No information
Med Sci Monit [28] (USA)	YES, CC-BY-NC-ND	2500 USD	NO	NO	NO	No information
PLoS One [36, 52] (Plos one, USA)	YES, CC-BY	1595 USD	NO	NO	NO	NO
Oral Surg Oral Med Oral Pathol	NO, 20 USD/article	2250 USD	NO	NO	NO	NO

Oral Radiol [59] (USA) (Mosby)						
Insights Imaging [68] Springer Open (USA)	YES, CC-BY	1822 USD plus VAT	NO	NO	NO	NO
Europe						
Eur J Dent [35] (Thieme, Germany)	YES, CC-BY-NC-ND	450 USD	No information	No information	No information	No information
Eur J Orthod [57] (Oxford University Press) (UK)	NO, 45 USD/article 771 USD/issue	4124 USD	NO	NO	NO	Color charges
Dentomaxillofac Radiol [39, 50, 51, 53, 62, 64, 66] (BIR, UK)	YES, CC-BY or CC-BY-NC (if author payed APC)	2702.2 USD	NO	NO	NO	NO
BMJ Case Rep [56] (UK) (BMJ Publishing Group)	NO, 37.50£/article	289.5 USD to become fellow/year	321 USD for open access	No information	No information	No information
Med Oral Patol Oral Cir Bucal [65, 69] (Spain)	YES, Articles free on PubMed	No information	No information	No information	No information	No information
Germs [49] (Romania)	YES, free articles on website	NO	NO	NO	NO	NO
Stomatologija (Baltic countries) [54, 60, 61]	YES, free articles on website	No information	No information	No information	No information	No information
Asia						
Med Princ Pract [47] (Kuwait) (Karger Publisher, CH)	YES, CC-BY-NC-ND	NO	NO	NO	NO	Color figures: 966.17 USD per page
Chin J Dent Res [38] (China)	NO information, pdf available for free on webpage	NO information	NO information	NO information	NO information	NO information
Iran Endod J (Iran) [32, 33, 40]	YES, CC-BY-NC-SA	450 USD	No information	250 USD: fast-track review in 4 weeks	No information	No information
J Dent (Shiraz) [48] (Iran)	NO information	135 USD	15 USD	No information	No information	No information
Acta Med Iran [55] (Iran)	YES, CC-BY-NC	White page on publication fees	No information	No information	No information	No information

J Conserv Dent [22 ,27] (India)	NO (20 USD/article, pdf to buy)	No information	NO	YES, 60 USD	No information	No information
Indian J Dent Res [30, 63] (India)	YES, CC-BY-NC-SA	NO	No information	No information	No information	150 USD
Indian J Dent [31] (India)	YES, CC-BY-NC-SA	111.8 USD	7 USD	No information	No information	No information
Restor Dent Endod [23, 29] (South Korea)	YES, CC-BY-NC	NO	NO	No information	No information	No information
Imaging Sci Dent [25, 46] (South Korea)	YES, CC-BY-NC	NO	NO	No information	No information	No information
Australia						
Aust Dent J [44] (Australia) (Wiley, USA)	NO (42 USD/article)	2500 USD	No information	No information	No information	No information
Africa						
Scientifica (Cairo) [24] (Hindawi publisher) (Egypt)	YES, if APC payed	950 USD	NO	NO	NO	NO
Niger J Clin Pract [42, 58] (Nigeria)	NO	150 USD	80 USD	No information	No information	No information

Open access was granted in 20 journals (71.4%). There was no open access available in 6 journals, and no information was given for 2 journals. 15 journals provided with Creative Commons (CC) license available for free or after paying author publications charges (APC). There were 6 journals proposing CC-BY license, 4 journals proposing CC-BY-NC license, 3 journals proposing CC-BY-NC-SA license, and 3 journals proposing CC-BY-NC-ND license. One journal applied two types of licenses (Dentomaxillofac Radiol).

15 journals applied APC varying from 111.8 USD (Indian J Dent) to 4124 USD (Eur J Orthod). Six journals do not applied APC, and there was no information for 7 journals. Fees at submission were asked by 4 journals, not asked by 16 journals, and there was no information for 8 journals. Fees at submission varied from 7 USD (Indian J Dent) to 321 USD (BMJ Cas Rep). Fees for review were asked by 2 journals, not asked by 13 journals, and there was no information for 13 journals. Fees for review varied from 60 USD (J Conserv Dent) to 250 USD (Iran Endod J). Fees for technical review were asked in 1 journal (Brazil Dent J, 300 USD), not asked in 11 journals, and there was no information for 16 journals. Printing fees were asked in 3 journals, not asked in 7 journals, and no information was provided for 18 journals. Printing fees varied from 150 USD (Indian J Dent Res) to 966.17 USD (Med Princ Pract).

Only 2 journals (J Appl Oral Sci and Germs) were completely free for authors and shared for free figures of anatomical variations from CBCT. There was no

information for 6 journals to conclude on their free publishing policy, and in 20 journals authors needed to pay for sharing their figures.
Finally, there were 15 annotated and 3 not annotated figures published for free and shared for free when comparing Table 1 and Table 2 [34, 49].

Discussion

Validated information on human anatomical variations from CBCT exists behind payed walls established by dental journals and books [70] publishers. The 50 articles selected in this study represent only 2.24% of articles on human anatomical variations from CBCT that are freely available for readers on PubMed. There exists a very limited range of available subjects of interest accessible for free. Especially there exist no free articles on syndromes except cleidocranial dysplasia [67] (around 5000 syndromes exist in oral and maxillofacial area), and cleft palate patients, on oncology related studies (i.e., osteonecrosis), on bone diseases in oral and maxillofacial area (only 4 diseases presented [40, 53, 55, 56]), on teeth anomalies not related to endodontics (only 1 study on dens invaginatus [41]), on paranasal sinuses (only 2 studies on maxillary sinus [45, 47]).
There exists no free study on temporal bone, or on soft tissue calcifications on CBCT. Anatomical variations of teeth such as roots variations, and position variations may explain troubles of teeth eruption in orthodontics. No one article is freely available on this topic. Variations of mandibular nerve canals do not exist in free version. There exist no free studies on cervical spine (except 2 studies on ponticulus posticus [58, 59]). Majority of free articles are single studies on one specific topic. However, as anatomical variations may vary between populations, single studies cannot give any answer to a general practitioner from a given population.
Annotated figure (i.e., with arrows) is a privileged way to explain anatomical variation more precisely than only with a brief description of a figure. Annotated figures are therefore addressed to more general public or to general practitioners that represent the most important part of clinicians. Not annotated figures are more addressed to a specialized clinical public or to other researchers. In current situation freely accessible figures are more addressed to a specialized target group and less to general practitioners as there exist 287/704 (41%) annotated and 417/704 (59%) not annotated figures freely accessible for readers.
Articles are dispersed over 28 different journals which means that there is currently no leading journal on anatomical variations from CBCT in dental literature. Dentomaxillofacial Radiology, which is the leading journal in the domain of dentomaxillofacial radiology, contains 7 such articles. However, this journal proposes open access only after paying with APC of 2702 USD, and thus limits any attempt to publish free figures for readers. The majority of journals (71.4%) applied diverse types of fees implying that very few authors were able to choose the open access and were able to share their figures with the public. Therefore, open access does not mean free publishing for authors, but only free access for readers. Only two

journals were completely free for authors and for readers, and were not belonging to major medical publishing groups.
The 15 annotated and 3 not annotated figures published for free and shared for free represent an exception in dental literature and are far away from any future world of Open or Free science.
Currently, clinicians using available scientific journals have no chance to found within minutes, during their dental practice, a freely available figure corresponding to any type of anatomical variation that may arise in dental and maxillofacial CBCT and that could help them immediately in their diagnosis and/or treatment plan.

Digital revolution has offer changes and opportunities; scholarly publishing could be done on- line that reduces the printing costs dramatically. Universities can play a vital role in this process by sharing the knowledge they are producing much more than before. The reach out to different communities and stakeholder groups could help make the science more relevant and connected with everyday life.
Traditional scholarly publishing system is based on work of academics. Researcher carries out the scientific work from the concept, to the design of the methodology and conducting the experiment - to the final drafting of the articles. Researchers are peer reviewing other papers, and researchers must format the whole article in a way that is ready for publication.
Publishers paid none of these tasks, and scientists must give up their copyrights in order to get their work published. In other words, somebody else is selling its work as a commercial product.
Open Science is a new approach that promotes sharing the knowledge and data as soon as possible, not waiting for the final article text, but try to share and interact with others from the moment that the concept has been born.
Open science is also a mean: "Open science strategies and policies are a means to support better quality science, increased collaboration, and engagement between research and society that can lead to higher social and economic impacts of public research." https://www.innovationpolicyplatform.org/content/recent-findings-and-policy-messages-open-science
The traditional impact factor – based system of publications has derailed the science, researchers need to publish original papers only, and simple case studies are often not welcomed by big editorial houses. Citizens and practitioners in the field, as dentists in our case - feel not connected with scientific publications. In order to build the interest and trust in science – research must become more collaborative, more engaging and may be simpler.
University could be socially engaged and embrace the new approach. Open Science gives them opportunity to share the knowledge, to bridge the gap and to reach out to the large populations. The interest in science is enormous. For example, use of data from PubMed Central, the online repository of the US National Institutes of Health https://www.ncbi.nlm.nih.gov/pubmed/, shows that 25% of the daily unique users are from universities, 17% from companies, 40% are individual citizens and the rest are from government or in other categories – (from UNESCO, Policy Guidelines for the Development and Promotion of Open Access, UNESCO Publishing, 2012.)

The debate of future of scholarly publishing is going on for some time (https://www.eosc-portal.eu/sites/default/files/KI0518070ENN.en_.pdf). Researchers claim the science back. The concept of Open Science gives the opportunity to change the rules of the game. Universities should take this opportunity and engage with society. Universities could using its knowledge and infrastructure continue to do the work, they have been always doing, but this time keeping their copyrights.

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Authors contribution:

Author	Contributor role
Olszewski R	Conceptualization, Data curation, Investigation, Methodology, Resources, Validation, Writing original draft preparation, Supervision, Writing review and editing
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