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

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Introduction

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

57

58   Incidental findings and anatomical variations [1] should be of interest for dentists
59   using CBCT in daily practice [2, 3]. Multiple retrospective studies on incidental
60   findings on CBCT [4, 5] were already performed on diverse human populations such
61   as in Germany (1029 CBCT) [6], United States (between 200 and 1000 CBCT
62   depending of a study) [7-11], Canada (427 CBCT [12] and 7689 CBCT specifically
63   about clivus and cervical spine [13]), Brazil (150 CBCT) [5-14], Switzerland (999
64   CBCT) [15], India (201 CBCT of maxillary sinus) [16], Iran (198 CBCT of
65   maxillary sinuses) [17], Turkey (207 CBCT) [18], and South Korea (500 CBCT)
66   [19].

67

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

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

77

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

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83   We wanted to know in the present study how many figures were shared with the
84   public without payment and what were the types of anatomical variations described
85   on CBCT and accessible for free from PubMed. We also wanted to analyze how
86   many figures were annotated (with clear visual information e.g. arrows showing
87   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%)

126 articles, with 8/306 (2.61%) annotated, and 79/432 (18.28%) not annotated figures;
127 7) mandible: 3/50 articles (6%), with 19/306 (6.2%) annotated, and 15/432 (3.47%)
128 not annotated figures; 8) orthodontics: 2/50 articles (4%), with 11/306 (3.59
129 %) annotated, and 65/432 (15.04%) not annotated figures; 9) dentomaxillofacial
130 radiology (general): 1/50 articles (2%), with 16/306 (5.22%) annotated, and 13/432
131 (3%) not annotated figures; 10) periodontics: 1/50 articles (2%), with 3/306 (0.98%)
132 annotated, and 3/432 (0.69%) not annotated figures.
133 The 38/50 (76%) articles are single studies on one specific topic. Only 3 topics
134 (endodontic study on teeth 17 and 27, endodontic study on teeth 37 and 47, and
135 description of variations of ponticulus posticus in C1 vertebra) are presented in 2
136 studies. Two topics (endodontic study on teeth 16 and 26, and one study on root
137 fractures) are described in 3 studies. Number of figures with annotations vary from 1
138 to 31 per article, and without annotations from 1 to 69 per article.
139
140 **Table 1. Sharing of figures and type of studied anatomical variations**
141 **from CBCT.**
142

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**

143
144   28 journals participated in the effort to free sharing figures on anatomical
145 variations from CBCT (Table 2). All continents were involved. The countries the
146 most involved were USA (5 journal titles), UK (3 journal titles), Brazil (3 journal
147 titles), India (3 journal titles), and Iran (3 journal titles). There were from 1 to 7
148 articles (Dentomaxillofacial radiology) published in these 28 journals. There were
149 11 journals (20 articles) published by 11 major professional publishers.
150
151 **Table 2. Journals sharing figures of anatomical variations from CBCT.**
152

	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

153
154   Open access was granted in 20 journals (71.4%). There was no open access
155 available in 6 journals, and no information was given for 2 journals. 15 journals
156 provided with Creative Commons (CC) license available for free or after paying
157 author publications charges (APC). There were 6 journals proposing CC-BY license,
158 4 journals proposing CC-BY-NC license, 3 journals proposing CC-BY-NC-SA
159 license, and 3 journals proposing CC-BY-NC-ND license. One journal applied two
160 types of licenses (Dentomaxillofac Radiol).
161 15 journals applied APC varying from 111.8 USD (Indian J Dent) to 4124 USD (Eur
162 J Orthod). Six journals do not applied APC, and there was no information for 7
163 journals. Fees at submission were asked by 4 journals, not asked by 16 journals, and
164 there was no information for 8 journals. Fees at submission varied from 7 USD
165 (Indian J Dent) to 321 USD (BMJ Cas Rep). Fees for review were asked by 2
166 journals, not asked by 13 journals, and there was no information for 13 journals.
167 Fees for review varied from 60 USD (J Conserv Dent) to 250 USD (Iran Endod J).
168 Fees for technical review were asked in 1 journal (Brazil Dent J, 300 USD), not
169 asked in 11 journals, and there was no information for 16 journals. Printing fees
170 were asked in 3 journals, not asked in 7 journals, and no information was provided
171 for 18 journals. Printing fees varied from 150 USD (Indian J Dent Res) to 966.17
172 USD (Med Princ Pract).
173
174 Only 2 journals (J Appl Oral Sci and Germs) were completely free for authors and
175 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 maxillo-facial area (only 4 diseases presented [40, 53, 55, 56]), on teeth anomalies not relat-ed to endodontics (only 1 study on dens invaginatus [41]), on paranasal sinuses (on-ly 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

218 journals were completely free for authors and for readers, and were not belonging to
219 major medical publishing groups.
220 The 15 annotated and 3 not annotated figures published for free and shared for free
221 represent an exception in dental literature and are far away from any future world of
222 Open or Free science.
223 Currently, clinicians using available scientific journals have no chance to found
224 within minutes, during their dental practice, a freely available figure corresponding
225 to any type of anatomical variation that may arise in dental and maxillofacial CBCT
226 and that could help them immediately in their diagnosis and/or treatment plan.
227
228 Digital revolution has offer changes and opportunities; scholarly publishing could
229 be done on- line that reduces the printing costs dramatically. Universities can play a
230 vital role in this process by sharing the knowledge they are producing much more
231 than before. The reach out to different communities and stakeholder groups could
232 help make the science more relevant and connected with everyday life.
233 Traditional scholarly publishing system is based on work of academics. Researcher
234 carries out the scientific work from the concept, to the design of the methodology
235 and conducting the experiment - to the final drafting of the articles. Researchers are
236 peer reviewing other papers, and researchers must format the whole article in a way
237 that is ready for publication.
238 Publishers paid none of these tasks, and scientists must give up their copyrights in
239 order to get their work published. In other words, somebody else is selling its work
240 as a commercial product.
241 Open Science is a new approach that promotes sharing the knowledge and data as
242 soon as possible, not waiting for the final article text, but try to share and interact
243 with others from the moment that the concept has been born.
244 Open science is also a mean: "Open science strategies and policies are a means to
245 support better quality science, increased collaboration, and engagement between
246 research and society that can lead to higher social and economic impacts of public
247 research."   https://www.innovationpolicyplatform.org/content/recent-findings-and-
248 policy-messages-open-science
249 The traditional impact factor – based system of publications has derailed the science,
250 researchers need to publish original papers only, and simple case studies are often
251 not welcomed by big editorial houses. Citizens and practitioners in the field, as
252 dentists in our case - feel not connected with scientific publications. In order to build
253 the interest and trust in science – research must become more collaborative, more
254 engaging and may be simpler.
255 University could be socially engaged and embrace the new approach. Open Science
256 gives them opportunity to share the knowledge, to bridge the gap and to reach out to
257 the large populations. The interest in science is enormous. For example, use of data
258 from PubMed Central, the online repository of the US National Institutes of Health
259 https://www.ncbi.nlm.nih.gov/pubmed/, shows that 25% of the daily unique users
260 are from universities, 17% from companies, 40% are individual citizens and the rest
261 are from government or in other categories – (from UNESCO, Policy Guidelines for
262 the Development and Promotion of Open Access, UNESCO Publishing, 2012.)

263   The debate of future of scholarly publishing is going on for some time
264   (https://www.eosc-portal.eu/sites/default/files/KI0518070ENN.en_.pdf).
265   Researchers claim the science back. The concept of Open Science gives the
266   opportunity to change the rules of the game. Universities should take this
267   opportunity and engage with society. Universities could using its knowledge and
268   infrastructure continue to do the work, they have been always doing, but this time
269   keeping their copyrights.
270

271

279   **Authors contribution:**

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

280

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