



1 **Contribution of dental private practitioners to**
2 **publications on anatomical variations using**
3 **cone beam computed tomography.**

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Objective: To investigate the participation of citizens-dental private practitioner in scientific articles about anatomical variations on dentomaxillofacial CBCT. Our null hypothesis was that private practice practitioners are not involved in publications on anatomical variations using cone beam computed tomography.

Material and methods: This study was performed from home without access to our university library. Only PubMed database was used to perform our study. We found 384 articles published among 1830 articles corresponding to our inclusion/exclusion criteria. For each selected article we searched for affiliation of all of the authors (university, private dental practice, students, other). We applied a co-creation approach to involve colleagues from private practice in analyzing results of this study.

Results: A large majority of authors have university affiliation (96.5%). Only 3% of authors come from private practice. Most of articles belong to the group of 7 emergent economies (E7), and from Asia. 47.9% of 96 journals published only one article on anatomical variations discovered on CBCT. The higher number of articles (18.75%) were published by journals related to endodontics. The 84% of articles were dispersed among a vast span of general and specific dental, and maxillofacial journals. The 68.4% of articles on variations in CBCT were available in closed access and 31.6% of articles were available in open access. Only 6.7% of articles were published in open access without author publication charges (APC). The 31.6% of authors with university affiliation choose open access for their article. 7.8% of authors from private practice were involved in publishing in closed access journals and 2.34% in open access journals. Only 3 articles (0.78%) were published by authors affiliated to private practice without involvement of university authors. 2.6% of articles involved students as co-authors. Authors with other affiliation were involved only in one closed access publication. For the step of co-creation none of 183 private practitioners, and 3/33 (9%) university-affiliated members of Nemesis Facebook group actively participated in analyzing the results of this study.

Conclusions: the null hypothesis was accepted: dentists from private practice are exceptionally involved in publications on anatomical variations using CBCT in dentomaxillofacial area.

Keywords: cone beam computed tomography, CBCT, anatomical variation, citizen science, open access

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Introduction

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Citizen participative science is emerging part of open science practices. Open science means sharing as early as possible and not only between academics but with non-academics as well (<https://discovery.ucl.ac.uk/id/eprint/10058422/>). In medical research, participative science is not very popular. Patients are only considered as subject of the research, and sharing knowledge and data with patients is difficult because of the medical secret and of data protection. However, word "citizen" in citizen participative science refers to voluntary participation by nonprofessional contributors or professional contributors not involved in academic career. Building on our previous article on accessibility to the knowledge on anatomical variations from dentomaxillofacial cone beam computed tomography (CBCT) we found that articles on that topic with free open access represent an exception in dental literature [1]. Private practitioners were not able to quickly find pertinent reference figures on anatomical variation arising in dentomaxillofacial CBCT imaging [1]. The objective of our article was double: 1) to investigate the participation of citizens-dental private practitioner in scientific articles on anatomical variations on dentomaxillofacial CBCT, and 2) to involve citizens-private practice practitioners as well as their scholarly colleagues in analyzing results on the present study, and to evaluate the issues and limitations of this approach. Our null hypothesis was that private practice practitioners are not involved in publications on anatomical variations using cone beam computed tomography.

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Materials and methods

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The study was performed from home without access to our university library. We worked in the same experimental conditions as our private practice colleagues to access free scientific knowledge. We used some elements from systematic review methodology to find articles in a reproducible manner. The Scopus (institutional access only) and Embase (payment) databases were not used. Only PubMed database was used to perform our study. We wanted to search as many as possible articles on anatomic variations discovered and/or described in studies using CBCT. Our research equation for PubMed was set as follow:

(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])) AND (hasabstract[text] AND "humans"[MeSH Terms] AND (English[lang] OR French[lang])). We accessed on PubMed on 24.07.2019.

There was no time frame for our search (1948-2019). The languages selected were English and French. The inclusion criteria were set as follow: studies on CBCT on human anatomical variation in dentomaxillofacial area, studies with abstract. Clinical studies, case series and case reports were also selected.

140 The exclusion criteria were: experimental studies, in vitro studies, cadaver studies,
141 studies without information on anatomical variation in dentomaxillofacial CBCT
142 area, CBCT studies other than on dentomaxillofacial area, no author information, no
143 abstract.

144 One observer performed the search. The research equation provided with 1830
145 articles. Articles were then selected according to inclusion/exclusion criteria on
146 lecture of title and abstract. Articles were also excluded because of insufficient
147 information on author affiliation in PubMed database or on the journal webpage.
148 Finally, we found 384 articles [2-385].

149 For each selected article, we searched for affiliation of all of the authors. We needed
150 to search the information about author affiliation on the journal webpage when it
151 was not directly accessible from PubMed database. We subdivided affiliations onto:
152 1) University, 2) private practice, 3) student, 4) other occupation. Mixed affiliation
153 university and private practice was considered as university affiliation as the author
154 was able to use university access to his/her study. The student affiliation was
155 reserved for student before final graduation (not PhD students). We used the
156 category “other occupation” for radiological technicians.

157 We searched information about author's countries, and on journals publishing on
158 anatomical variations using CBCT. We wanted to know about the involvement of
159 different categories of authors in open access publication. We systematically
160 accessed to all journals webpages of all selected articles. We checked if the pdf file
161 was really accessible in open access journals. We searched for information on open
162 access type in instruction for authors which were of two types: with and without
163 author publication charges (APC).

164 The next step of methodology consisted of a co-creation approach to involve
165 colleagues from our and other university dental departments, and from private
166 practice in analyzing results and in writing conclusions.

167 A first draft of the article, composed of methodology and of 4 tables (Tables 1, 2,
168 13, and 14) with search results was published on the website of Nemesis. This was
169 formulated as an invitation to participate in the article and to write the analysis of
170 results. The Nemesis journal uses also social media – a group was created on
171 Facebook (in April 2020), where 228 members have subscribed. There were 183
172 private practitioners and 33 university affiliated members. The invitation and the
173 link to the draft was posted on Facebook (19 May 2020). One month deadline (until
174 19 June 2020) was set in to contribute to the article drafting. Potential participants
175 have been informed that this is an experimental approach and were given the
176 possibility to contact the editor-in-chief for any question.

177 After one month, all contributions have been collected by email and incorporated to
178 the new draft. All participants were given a new opportunity to comment through a
179 new invitation and link to the 2nd draft posted on Facebook. This time the
180 participants were also asked to give their feedback why they think that so little
181 private practice dentist are participating in scientific research and publication.

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Results

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From the Table 1 we can see that publication on CBCT anatomical variations started from 1999 onwards. Total number of articles on CBCT anatomical variations was multiplied by 7 comparing the same period of time before and after 2011. Total number of authors was multiplied by 20 comparing the same period of time before and after 2011. The number of authors/article tripled after 2011. A vast majority of authors have university affiliation (96.5%). Only 3% of authors come from private practice. Student involvement in publications is almost nonexistent (0.5%). Between 2011-2019 appears a small but progressive lack of correct information on authors on Pubmed, and in the same period of time correct information on authors is achieved in scholarly journals.

Table 1. Information on included and excluded articles and on number and type of author's affiliation.

Years	Number of articles	Number of authors	Number of included articles	Number of excluded articles	Number of excluded articles with insufficient information	Number of authors with university affiliation	Number of private practice authors	Number of student authors	Number of other type of affiliations authors
2015-2019	800	1049	214	567	19	1002	40	7	0
2011-2015	800	737	152	620	28	720	13	4	0
1999-2011	230	84	18	210	2	80	3	0	1
1999-2019	TOTAL =1830	1870	384	1397	49	1802	56	12	1

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The total number of articles from Tables 2-12 (n=475) is different from 402 articles from Tables 1, 13, and 14. Some articles were written together by colleagues from different countries, and counted separately for each country. United States and Turkey are the most publishing country on CBCT anatomical variations (Table 2). Most of articles come from the group of 7 emergent economies (E7) (Table 4), and from Asia (Table 10). Publications on CBCT variations in European Union (Table 5) with the longest scholarly traditions are below G7 (Table 3) and BRICS (Table 6) countries. The 8 of 10 European countries from ex-sovietic bloc have no published articles on CBCT variations in PubMed. Russia also has no oarticle on that topic. When we compare the continents, 44.7% of articles belong to Asia (Table 10), 25.3% to Europe (Tables 5, 7), 15.4% to North America (Table 8), and 12.1% to South America (Table 9). Africa (Table 11), and Oceania (Table 12) are deeply underrepresented (Fig. 1).

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215**Table 2.** The total number of articles by authors countries. The list of countries is arranged alphabetically for the same number of articles.

Country of affiliated authors	The total number of articles
USA	67
Turkey	67
Brazil	49
China	38
India	31
South Korea	19
Spain	19
UK	17
Japan	16
Switzerland	16
Italy	15
Germany	11
Romania	11
Iran	8
Taiwan	8
Belgium	6
Portugal	6
Canada	5
France	5
Hong-Kong	5
Israel	5
Saudi Arabia	5
Australia	4
Egypt	4
Malaysia	4
Croatia	3
Greece	3
Poland	3
South Africa	3
Argentina	2
Chili	2
Syria	2
The Netherlands	2
Belarus	1
Costa Rica	1
Danmark	1
Finland	1
Georgia	1
Iceland	1
Iraq	1
Jamaica	1
Jordan	1
Mexico	1

Norway	1
Oman	1
Thailand	1
Venezuela	1
Total=47 countries	Total=475 articles

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218**Table 3.** The total number of articles by countries belonging to G7 (major developed countries).

Country	The total number of articles
USA	67
UK	17
Japan	16
Italy	15
Germany	11
France	5
Canada	5
Total= 7	Total=136

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221**Table 4.** The total number of articles by countries belonging to E7 (emerging economy countries).

Country	The total number of articles
Turkey	67
Brazil	49
China	38
India	31
Mexico	1
Indonesia	0
Russia	0
Total=7	Total=186

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224**Table 5.** The total number of articles by countries belonging to European Union.

Country	The total number of articles
Spain	19
Italy	15
Germany	11
Romania	11
Belgium	6
Portugal	6
France	5
Croatia	3
Greece	3
Poland	3
The Netherlands	2
Denmark	1
Finland	1
Austria	0

Bulgaria	0
Cyprus	0
Estonia	0
Hungary	0
Ireland	0
Latvia	0
Lithuania	0
Luxembourg	0
Malta	0
Czechia	0
Slovakia	0
Slovenia	0
Sweden	0
Total= 27	Total=86

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Table 6. The total number of articles by countries belonging to BRICS countries.

Country	The total number of articles
Brazil	49
China	38
India	31
South Africa	3
Russia	0
Total=5	Total=121

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Table 7. The total number of articles by countries belonging to European countries other than European Union.

Country	The total number of articles
UK	17
Switzerland	16
Belarus	1
Iceland	1
Norway	1
Total=5	Total=36

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Table 8. The total number of articles by countries in North America.

Country	The total number of articles
USA	67
Canada	5
Mexico	1
Total=3	Total=73

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Table 9. The total number of articles by countries in South America.

Country	The total number of articles
Brazil	49
Argentina	2

Chili	2
Costa Rica	1
Jamaica	1
Venezuela	1
Total=6	Total=56

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Table 10. The total number of articles by countries in Asia.

Country	The total number of articles
Turkey	67
China	38
India	31
South Korea	19
Japan	16
Iran	8
Taiwan	8
Hong-Kong	5
Israel	5
Saudi Arabia	5
Malaysia	4
Syria	2
Georgia	1
Iraq	1
Jordan	1
Thailand	1
Oman	1
Total=17	Total=213

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Table 11. The total number of articles by countries in Africa.

Country	The total number of articles
Egypt	4
South Africa	3
Total= 2	Total=7

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Table 12. The total number of articles by countries in Oceania.

Country	The total number of articles
Australia	4

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Fig. 1. The total number of articles by continents.

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The 46 of 96 journals (47.9%) published only one article on anatomical variations discovered on CBCT (Table 13). The higher number of articles (18.75%) were published by journals related to endodontics. Journal with the scope of dentomaxillofacial radiology accepted only 15.36% of all articles on anatomical variations on CBCT. Therefore, 84% of articles were dispersed among a large span of general and specific dental, and maxillofacial journals.

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Table 13. The total number of articles by journal titles. The list of journals is arranged alphabetically for the same number of articles.

Journal Title	The total number of articles
J Endod	54
Surg Radiol Anat	42
Int Endod J	17
J Craniofac Surg	13
Oral Surg Oral Med Oral Pathol Oral Radiol	13
Clin Oral Investig	11
Clin Implant Dent Relat Res	10
Dentomaxillofac Radiol	10
Implant Dent	9
J Contemp Dent Pract	8
Int J Oral Maxillofac Surg	7
Rom J Morphol Embryol	7
Acta Odontol Scand	6
Am J Orthod Dentofacial Orthop	6
Braz Dent J	6
Braz Oral Res	6
Head Face Med	5
Indian J Dent Res	5
J Oral Maxillofac Surg	5
Niger J Clin Pract	5
PLoS One	5
Ann Anat	4
Arch Oral Biol	4

Clin Oral Implant Res	4
Eur J Orthod	4
Forensic Sci Int	4
J Forensic Sci	4
J Formos Med Assoc	4
Med Oral Patol Oral Cir Bucal	4
Minerva Stomatol	4
Oral Maxillofac Surg	4
Angle Orthod	3
Biomed Res Int	3
BMC Med Imaging	3
Br J Oral Maxillofac Surg	3
Dent Clin North Am	3
Eur Arch Otorhinolaryngol	3
Int J Oral Sci	3
J Appl Oral Sci	3
J Craniomaxillofac Surg	3
J Oral Implantol	3
Acta Odontol Latinoam	2
Aust Dent J	2
BMC Oral Health	2
Clin Anat	2
J Forensic Leg Med	2
J Investig Clin Dent	2
J Oral Rehabil	2
Med Princ Pract	2
Sci Rep	2
Acta Med Acad	1
Acta Radiol	1
Anat Sci Int	1
Aust Endod J	1
Br Dent J	1
Bull Tokyo Dent Coll	1
Clin Imaging	1
Compend Contin Educ Dent	1
Cranio	1
Dental Press J Orthod	1
Dent Traumatol	1
Diagn Interv Radiol	1
Eur Rev Med Pharmacol Sci	1
Folia Morphol (Warsz)	1
Georgian Med News	1
Ger Med Sci	1
In Vivo	1
Int Dent J	1
Int J Artif Organs	1
Int J Legal Med	1
Int J Pediatr Otorhinolaryngol	1

J Am Dent Assoc	1
J Anat	1
J Clin Periodontol	1
J Coll Physicians Surg Pak	1
J Dent Child (Chic)	1
J Indian Soc Pedod Prev Dent	1
J Oral Sci	1
J Orthod	1
J Prosthet Dent	1
J Prosthodont	1
J Zhejiang Univ Sci B	1
Leg Med (Tokyo)	1
Med Sci Monit	1
Microsc Res Tech	1
Morphologie	1
Mymensingh Med J	1
Odontology	1
Okajimas Folia Anat Jpn	1
Oral Dis	1
Orthod Craniofac Res	1
Prog Orthod	1
Radiol Med	1
Rev Stomatol Chir Maxillofac	1
Saudi Med J	1
Sultan Qaboos Univ Med J	1
Total= 96 journals	Total=384 articles

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The 68.4% of articles on variations in CBCT were available in closed access, and 31.6% of articles were available in open access (Table 14). However, only 6.7% of articles were published in open access without author publication charges (APC). The 31.6% of authors with university affiliation choose open access for their article. The 24.7% of authors with university affiliation published in journals with open access and APC. The 6.7% of authors with university affiliation published in journals with open access and without APC. The 7.8% of authors from private practice were involved in publishing in closed access journals and 2.34% in open access journals. Only 3 articles (0.78%) were published by authors affiliated to private practice without involvement of university authors. Students were involved as co-authors in 2.6% of articles. Authors with other affiliation were involved only in one closed access publication (Fig. 2.).

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Table 14. Open and closed access publication type for selected articles.

	CA + UNI	CA + UNI + Priv	CA + UNI + Student	CA + Priv	CA + UNI + Tech	OA + APC+ UNI	OA + APC + UNI + Priv	OA + APC + UNI + Student	OA with NO APC + UNI	OA with NO APC + UNI + Priv
Total= 384 articles	226	27	6	3	1	84	7	4	24	2

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CA: closed access, OP: open access, APC: author publication charges, UNI: author university affiliation, Priv: author private practice affiliation, Student: author is a student from a given university, Tech: author is a technician affiliated to University clinic.

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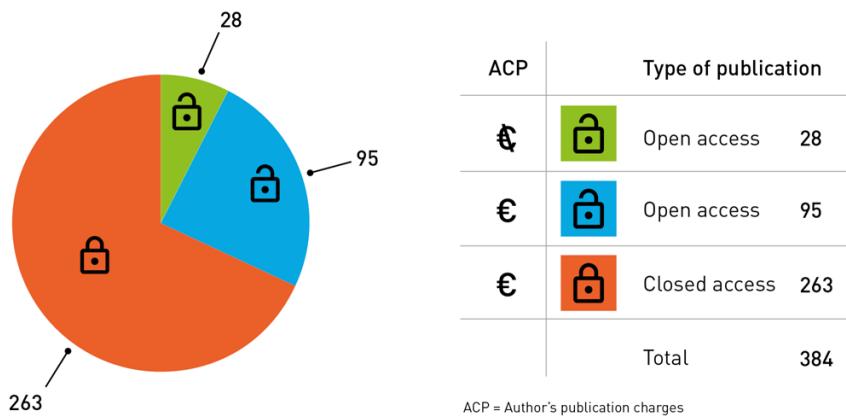
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Fig. 2. The total number of articles related to the type of access, and presence or absence of author publication charges.

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For the step of co-creation only 3 of 33 (9%) university affiliated members of Nemesis Facebook group answered after the first call, and one university affiliated member answered again after the second call. There was no involvement of any of 183 private practitioners from Nemesis Facebook group.

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Discussion

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The interest in describing human anatomical variation discovered on CBCT is increasing in scholarly literature (Table 1). However, the role of private practitioner in its development is not significant (Table 1). Various hypotheses can be put forward to explain the low participation of private practitioners without university affiliation in scientific publications on anatomical variations on CBCT. The research

306 itself and the science community may be difficult to access and seems to be reserved
307 to a kind of elite. Scientific literature is not easily accessible as the majority of
308 articles are accessible under closed access-paywalls (Table 14, Fig. 2). There exists a
309 real difficulty for private practitioner to produce a publication with sufficient quality
310 required by scholarly journals, and without any collaboration with scholarly experts
311 (methodology aspects, scientific writing, publication process). The private
312 practitioner may also feel overwhelmed by the large number of scientific
313 publications and thus not feel up to date or not feel able to make an original
314 contribution. The private practitioner may lack training in analyzing the whole
315 CBCT field of view, and remain focused only on their area of interest. They may
316 therefore not observe the anatomical variations. There may be a lack of details in
317 received protocols as they only answer to question asked by practitioners. The latter
318 is not aware of the existence of anatomical variations. Another difficulty may come
319 from access to the CBCT device which is more difficult in private practice than in
320 hospitals and/or university clinics even if this tends to improve in recent years.
321 Quantity of articles related to anatomical variations on CBCT is in relation with the
322 economic power of given country, geographic area, or economic club (Tables 2-12).
323 Articles are written in areas where there is an easy access to CBCT technology.
324 CBCT is still expansive in comparison with conventional dental radiography. It
325 needs the national implementation of special laws for patients radioprotection, and
326 its safe and justified use by the dental practitioner. There is also a major need of
327 post-university education for dentists, and maxillofacial surgeons using CBCT on
328 daily basis, as CBCT was only introduced in dental practice from 2003. CBCT is
329 also used for advanced dentistry (endodontics, implantology) which can be
330 performed only in economically stable countries due to higher costs.
331 Prevalence and type of anatomical variations seen on CBCT are different for
332 different human populations [3, 13-15, 22, 23, 26, 35, 38, 64, 69, 79, 84, 88, 94, 99,
333 103, 106, 128, 131, 150, 151, 153, 162, 170, 174, 177, 178, 181, 197, 202, 209, 212,
334 217, 226, 229, 230, 232, 241, 244, 245, 253, 255, 270, 279, 282, 288, 293, 297, 303,
335 308, 313, 323, 325, 327, 343, 346, 349, 358, 360, 364, 370, 378]. Some populations
336 are currently better described than other (55.4% of articles from Asia vs 31.7% from
337 Europe). Anatomical variations on dentomaxillofacial CBCT still wait to be
338 discovered on continents such as Africa and Oceania.
339 There is no real recognized leader journal which may accept the majority of articles
340 related to anatomic variations discovered on CBCT (Table 13). Such articles may be
341 single case reports that are known to be further less cited. Therefore, they will not be
342 or be scarcely accepted by Editors as they do not contribute to increase the impact
343 factor of a given journal.
344 In present situation a great majority of scholarly authors have no chance to access to
345 all of these journals through their university library, as they library should subscribe
346 to all of the titles from Table 13. Private practitioners have no chance at all to
347 quickly access to the information they need immediately when they are confronted
348 with a specific CBCT case in their own practice.

349 Variation of root canals in CBCT seems to be an overrepresented topic. From the
350 other hand, one article on a selected topic cannot itself embrace all the complexity of
351 a given type of CBCT variation.

352 Open access is an option more and more selected by university affiliation authors
353 (Table 14, Fig. 2). It seems not known by authors from private practice. However,
354 closed access to articles on CBCT anatomical variations is still the most prevalent.
355 This situation limits the advancement of research on human CBCT variations in
356 dentomaxillofacial area by scholarly authors with limited budget. Moreover, dentists
357 from private practice have no guarantee to find any reference figure to immediately
358 compare with their clinical case in the paid (closed access) article. Dental journals
359 without APC are very rare [1], and therefore articles with open access without APC
360 are still the rarest type of publication.

361 In our study, we decided to involve citizens, which are private practice dentists not
362 involved in any academic career. The incentive for active participation in our
363 research was to become co-author of the final version of the article. We also granted
364 the personalized contact with the Editor-in-Chief to overcome shyness of private
365 practitioners. However, none of 183 private practitioners answered to our two calls
366 through the Nemesis website, and through Facebook Nemesis group. We may
367 explain our failure by the fact that we asked not-research trained colleagues to
368 review a specific type of scholarly methodology using only a social media which is
369 mostly used for personal entertainment. We should rather try to organize a workshop
370 to clarify our expectations in face-to-face manner with our colleagues from private
371 practice. This approach was impossible this time due to Covid-19 situation in
372 Belgium.

373 The main limitation was the use of only one PubMed database, which was free of
374 use from home. Directory of Open access journals (DOAJ) was not selected. DOAJ
375 is a database which excludes closed access articles in any given topic, and therefore
376 which hidden the major issue of pay-walls in science. Barrier of language may also
377 be a bias in our study as only articles in English and French were selected. Russia is
378 an example of developed country with recognized scientific tradition, and with
379 missing data for our research. Russian authors may publish in their own language
380 and in journals not selected in PubMed database.

381 Finally, the null hypothesis was accepted: dentists from private practice are rarely
382 involved in publications on anatomical variations using CBCT in dentomaxillofacial
383 area.

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385

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390 in-Chief of Nemesis. All other authors declare no conflicts of interest.
- 391 • **Ethical approval:** There was no need for ethical committee approval for this
392 study.
- 393 • **Informed consent:** There was no need for informed consent for this study.

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Authors contribution:

Author	Contributor role
Hebda Aleksandra	Conceptualization, Methodology, Resources, Validation, Writing original draft preparation, Supervision, Writing review and editing
Theys Stéphanie	Validation, Writing original draft preparation, Writing review and editing
De Roissart Jean	Validation, Writing original draft preparation, Writing review and editing
Perez Eytan	Validation, Writing original draft preparation, Writing review and editing
Olszewski Raphael	Conceptualization, Data curation, Investigation, Methodology, Resources, Validation, Writing original draft preparation, Supervision, Writing review and editing

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