RESEARCH

Dental students' knowledge and attitudes towards cone beam computed tomography in Turkey

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Objective: The aim of this study was to evaluate students' knowledge and attitudes regarding cone beam CT (CBCT).

Methods: A questionnaire consisting of 11 questions was given to 472 dental students (280 pre-graduate and 192 post-graduate) at two institutions located in Ankara, Turkey (Ankara University, Faculty of Dentistry, and Gazi University, Faculty of Dentistry). Differences in responses by institution, education level and sex were statistically assessed with the χ^2 test.

Results: Statistical results showed that only 63.3% of students had heard of CBCT. Of these, 59.9% said they had learned about CBCT in their classes, 31.0% in seminars and 20.9% from the internet; 76.8% felt that CBCT was not given adequate coverage in their courses; 69% thought that CBCT should be taught as part of their clinical education; 91% thought it essential for CBCT to be available at dental faculties; 53.5% believed that the use of CBCT would become more widespread in the near future; and 84.9% wished to use CBCT technology in their future careers.

Conclusion: This research suggests that efforts should be made to improve students' knowledge base regarding CBCT and that the dental school curriculum should devote more curriculum time to this promising new technology.

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Introduction

Cone beam CT (CBCT) is an imaging modality that has recently become useful for dentomaxillofacial imaging. When compared with conventional CT scanners, CBCT units cost less and require less space, have rapid scan time, limit the beam to the head and neck, reduce radiation doses and have interactive display modes that offer maxillofacial imaging and multiplanar reformation, making them more suitable for use in dental practices.^{1,2} Drawbacks include beam hardening and scatter from dental materials and poor soft-tissue contrast.² Common indications for CBCT in dentistry include assessment of the jaws for placement of dental implants; examination of teeth and facial structures for orthodontic treatment planning; evaluation of the temporomandibular joints for osseous degenerative

changes; evaluation of the proximity of mandibular third molar teeth to the mandibular canal prior to extraction; and evaluation of teeth and bone for signs of infection, cysts and tumours.³ CBCT systems operate by focusing a cone-shaped X-ray beam on a two-dimensional (2D) detector that rotates 360° or less around the patient's head to produce a series of 2D images. A cone beam algorithm is then applied to this data set, allowing the operator to extract planar and curved reconstructions of varying thicknesses in any orientation and to generate accurate three-dimensional (3D) images of bone and soft-tissue surfaces.^{4–6}

In view of the increasing availability of CBCT in dental practices and the importance of dental students' attitudes towards new technologies, this survey assessed the knowledge and attitudes regarding CBCT among fourth and fifth year undergraduate and post-graduate dental students at the Ankara University, Faculty of Dentistry, and Gazi University, Faculty of Dentistry.

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Survey of CBCT among Ankara and Gazi University Dental Faculty students

1- Sex: 1. Male () 2. Female ()

2- Education level: 1. Fourth year () 2. Fifth year () 3. Post-graduate doctoral ()

3- Have you heard of cone beam CT (CBCT) used specifically for dentomaxillofacial?

1. Yes () 2. No ()

(The remaining questions were asked only of participants who responded "Yes" to Q3)

4- How did you obtain information regarding CBCT?

(Multiple responses are allowed.)

1. Faculty lessons ()

2. Seminars ()

3. Internet ()

4. Others () Please specify.....

5- Please number the following advantages of CBCT over medical CT from the most important (1) to the least important (7):

Lower radiation dose ()

Shorter scanning time ()

Less expensive ()

Occupies less space ()

Easier to maintain ()

Image processing is easier due to the limited beam ()

Data reconstruction can be performed on a personal computer ()

No idea ()

6- To what extent do you think CBCT will be used in routine dental practice in the near future?

In all areas of dentistry ()

For selected dental applications () Which ones? _____

It will not be commonly used in routine practice ()

No idea ()

7- Does your faculty provide adequate education regarding CBCT?

Yes ()

No () Please explain: _____

No idea ()

8- Which year of dental education should include lectures on CBCT?

Preclinical phase ()

Clinical phase ()

Doctoral phase ()

There is no need ()

9- Do you think it is necessary for a dental CBCT unit to be available at your faculty?

Yes ()

No ()

No idea ()

10- Would you choose to use CBCT in your future professional career?

Yes ()

No ()

No idea ()

11- For what cases would you choose to use CBCT in your future clinical dental career?

(Multiple responses are allowed.)

Implant dentistry ()

Extraction of impacted teeth ()

Evaluation of patients with tumours or cysts ()

Orthodontic assessment ()

All of the above ()

Other () _____

No need ()

Figure 1 Questionnaire used in the survey

Table 1 Knowledge level of students' regarding awareness of cone beam CT (CBCT)

		Ankara University (AU)			Gazi University (GU)		
Questions/ responses	Overall (AU+GU)	UGS		PGS	UGS		PGS
		DS4	DS5		DS4	DS5	
Question 3: Have you heard of CBCT used specifically for dentomaxillofacial?							
Yes	299 (63.3)	23 (31.1)	66 (79.5)	91 (74.6)	36 (63.2)	28 (42.4)	55 (78.6)
No	173 (36.7)	51 (68.9)	17 (20.5)	31 (25.4)	21 (36.8)	38 (57.6)	15 (21.4)
Total	472 (100)	74 (100)	83 (100)	122 (100)	57 (100)	66 (100)	70 (100)

Values in parentheses are percentages

UGS, undergraduate students; PGS, post-graduate students; DS4, fourth year student; DS5, fifth year students

Materials and methods

A self-administered anonymous questionnaire (Figure 1) consisting of 11 questions was designed and administered voluntarily to 472 (272 female, 200 male) students at the Ankara University (AU) Faculty of Dentistry and Gazi University (GU) Faculty of Dentistry consisting of 279 and 193 students, respectively. Of these, 280 were undergraduate students (UGS) and 192 were post-graduate students (PGS). The UGS included 131 fourth year students (DS4) and 149 fifth year students (DS5). In addition to collecting demographic information, the questionnaire assessed the respondents' general knowledge and attitudes towards CBCT.

A pilot survey was conducted with 20 students to validate the questionnaire and the full survey was implemented between December 2009 and July 2010. Data were analysed using the statistical software package SPSS 15.0 (IBM, New York, NY). Differences between institutions and between UGS and PGS responses were evaluated using χ^2 test (significance level was set at $P \leq 0.05$).

Results

No differences were found between the responses of male and female participants for any of the questions for each of the institutions. However, significant differences were found between the responses of UGS's and PGS's for the majority of questions

($P \leq 0.05$). Statistical results for both institutions were consistent for the majority of responses. No statistically significant difference was found between two institutions except for questions 5 and 9.

Question 3 (Table 1): The majority of participants had heard of CBCT. Awareness of CBCT was identical among DS5 and PGS and statistically higher than DS4 for AU. Results of GU showed that awareness of CBCT among PGS is more than UGS ($P = 0.00$). Unlike AU, GU results without statistically significant difference revealed that DS4 had more information than DS5.

Question 4: More than half of PGS (59.6%, $n = 87$) had learned about CBCT in seminars, compared with only 5 (3.3%) UGS ($P = 0.00$). In contrast, the majority of UGS (87.5%, $n = 133$) had learned about CBCT in faculty lessons, compared with only 45 (31%) PGS ($P = 0.00$). In addition, 20.9% of all participants ($n = 62$) had learned about CBCT from the internet. Other sources of information included friends and journals (11.4 %, $n = 34$).

Question 5 (Table 2): Overall, low radiation dose was given as the most important advantage of CBCT (61.7%, $n = 177$) and easier maintenance as the least important advantage (22%, $n = 63$). However, there were statistically significant differences in student responses by education level, with only 40.9% of DS4 ($n = 9$) citing low radiation dose as the greatest advantage of CBCT, compared with 58.7% of DS5 ($n = 37$, $P = 0.00$) at AU. Unlike AU, for radiation dose no statistically significant difference was found

Table 2 Percentage of students' first option responses to Question 5

Questions/response	Overall (AU+GU)	Ankara University (AU)			Gazi University (GU)		
		UGS		PGS	UGS		PGS
		DS4	DS5		DS4	DS5	
Low radiation dose	177 (61.7)	9 (40.9)	37 (58.7)	49 (58.3)	19 (52.8)	17 (63)	46 (83.6)
Image processing is easier because of limited beam to the head	12 (4.2)	1 (4.5)	2 (3.2)	8 (9.5)	1 (2.8)	0	0
Scanning time is short	11 (3.8)	1 (4.5)	1 (1.6)	2 (2.4)	3 (8.3)	2 (7.4)	2 (3.6)
Data reconstruction can be done on a personal computer	9 (3.1)	1 (4.5)	1 (1.6)	3 (3.6)	1 (2.8)	3 (11.1)	0
Maintenance is easier	8 (2.8)	1 (4.5)	2 (3.2)	1 (1.2)	1 (2.8)	1 (3.7)	2 (3.6)
Cheaper than conventional CT scanner	5 (1.7)	0	0	3 (3.6)	1 (2.8)	1 (3.7)	0
Occupy less space	5 (1.7)	0	1 (1.6)	2 (2.4)	0	1 (3.7)	1 (1.8)
No idea	63 (22)	9 (40.9)	19 (30.2)	15 (17.9)	10 (27.8)	5 (18.5)	4 (7.3)

Values in parentheses are percentages

UGS, undergraduate students; PGS, post-graduate students; DS4, fourth year student; DS5, fifth year students

between DS4 and DS5 for GU; however, PGS's response was considerably higher than UGS's (85.2%, 56.3%, respectively, $P = 0.00$).

Question 6 (Table 3): The majority of PGS (59%, $n = 85$) believed CBCT should be used in all types of dental procedures, compared with only 48.4% ($n = 74$) of UGS ($P = 0.001$). In contrast, only 5.6% of PGS ($n = 8$) thought CBCT would not be commonly used, compared with 16.3% ($n = 25$) of UGS. Differences in responses between the two groups were statistically significant ($P = 0.001$).

Question 7: The majority of both UGS (70.8%, $n = 109$) and PGS (83.3%, $n = 120$) stated that the faculty courses did not provide adequate information about CBCT.

Question 8: The majority of students (69%, $n = 205$) thought that information on CBCT should be included in clinical lectures (years 4–5), whereas 7.7% ($n = 23$) said they should be included in pre-clinical lectures (years 1–3) and 22.6% ($n = 67$) in doctorate (post-graduate) lectures. Very few students (0.7%, $n = 2$) said there was no need for CBCT education. While 79.2% of UGS stated that education regarding CBCT should be given in the clinical period, 36.4% of PGS expressed it should be taught in the doctoral phase ($P = 0.00$).

Question 9: The majority of participants (91%, $n = 272$) said they wanted a CBCT unit at their faculty. No statistical differences in responses were observed by education level; however, there is statistically significant difference between two institutions. While 99 (83.2%) students wanted CBCT in their faculty at GU, 173 (96.1%) AU students required CBCT ($P = 0.00$).

Question 10 (Table 4): The majority of participants (84.9%, $n = 254$) stated that they would use CBCT when treating patients during their future professional careers, only 3% ($n = 9$) said they did not expect to use CBCT and 12% ($n = 36$) did not know if they would use CBCT.

Question 11: The most frequently cited indication for CBCT was implant applications (43.6%), followed by tumour/cyst cases (33.1%). No statistical differences in responses were observed by education level for each of the institutes ($P = 0.1$).

Discussion

Studies assessing dental practitioners and students' knowledge about dental radiology have focused mainly on digital systems and radiation protection.^{7–11} While the literature does include one study that evaluates the effectiveness of web-based instruction in the interpretation of anatomy using CBCT images,¹² no information appears in the literature regarding students' knowledge and attitudes about CBCT.

The present study used a questionnaire to gauge the level of knowledge regarding CBCT among pre-graduate and post-graduate students. The survey was conducted in advance of the planned purchase of a CBCT system by both institutions.

The majority of participants were female, which reflects the demographics of the faculties as a whole; however, no differences in responses were found among female and male students for both institutions.

Overall, DS4 had little knowledge about CBCT, with less than half of students at this level having heard of the technology. Considering that DS5 are closer to entering their professional careers than DS4, it is understandable that they show more interest and awareness in new technologies like CBCT.

As the results of our survey show, UGS acquired much of their knowledge about CBCT from their courses at the dental faculty, whereas PGS learned about CBCT from seminars. Interestingly, the survey found that 70.8% of UGS and 83.3% of PGS felt the instruction given on CBCT was insufficient. Moreover, despite the inclusion of theoretical lessons on CBCT in radiology lectures on advanced imaging techniques, student awareness regarding CBCT was found to be rather low.

CBCT awareness in general is relatively new to Turkey and theoretical lessons on CBCT have only recently been included in the dental school curriculum. Considering the fact that there are only 20 CBCT units available throughout the entire country, it is not surprising that CBCT education remains limited to theoretical instruction (by comparison, 3000 CBCT units have been purchased in the USA and 800 in Germany¹³). Our study highlights the difficulties of acquiring knowledge about a system without practical

Table 3 Students' attitudes towards use of cone beam CT (CBCT) (by education level)

		<i>Ankara University (AU)</i>			<i>Gazi University (GU)</i>		
<i>Questions/responses</i>	<i>Overall (AU+GU)</i>	<i>UGS</i>		<i>PGS</i>	<i>UGS</i>		<i>PGS</i>
		<i>DS4</i>	<i>DS5</i>		<i>DS4</i>	<i>DS5</i>	
<i>Question 6: How do you expect CBCT will be used in the near future?</i>							
All procedures	159 (53.5)	7 (30.4)	24 (36.9)	53 (58.2)	24 (66.7)	18 (64.3)	33 (61.1)
Only certain procedures	73 (24.6)	5 (21.7)	18 (27.7)	28 (30.8)	2 (5.6)	6 (21.4)	14 (25.9)
Will not be used	33 (11.1)	8 (34.8)	10 (15.4)	3 (3.3)	5 (13.9)	2 (7.1)	5 (9.3)
Do not know	32 (10.8)	3 (13)	13 (20)	7 (7.7)	5 (13.9)	2 (7.1)	2 (3.7)
Total	297 (100)	23 (100)	66 (100)	91 (100)	36 (100)	28 (100)	54 (100)

Values in parentheses are percentages

UGS, undergraduate students; PGS, post-graduate students; DS4, fourth year student; DS5, fifth year students

Table 4 Students' attitudes towards the use of cone beam CT (CBCT) (by education level)

		Ankara University (AU)			Gazi University (GU)		
		UGS		PGS	UGS		PGS
Questions/responses	Total AU+GU	DS4	DS5		DS4	DS5	
Question 10: Would you use CBCT in your future career?							
Yes	254 (84.9)	18 (78.3)	54 (81.8)	84 (92.3)	29 (80.6)	24 (85.7)	45 (81.8)
No	9 (3)	2 (8.7)	5 (7.6)	0 (0)	1 (2.8)	0	1 (1.8)
No Idea	36 (12)	3 (13)	7 (10.6)	7 (7.7)	6 (16.7)	4 (14.3)	9 (16.4)

Values in parentheses are percentages

UGS, undergraduate students; PGS, post-graduate students; DS4, fourth year students; DS5, fifth year students

experience. The lack of a CBCT unit at both institutions seems to have played a significant role in students' unfamiliarity with this technology. As student responses (particularly to Questions 9 and 10) indicate, theoretical education must be supplemented by routine practice with CBCT.

In conclusion, CBCT is one of the most significant new developments in modern dentistry. It possesses many advantages over medical CT, including much lower doses

of radiation. This high-quality imaging technology should be adopted by dentists, and dental students should be provided with appropriate CBCT education supported by practical experience. Considering the results of the present survey, it is apparent that dental students from both institutions want CBCT to be available at their oral radiology departments. In addition, more detailed information regarding CBCT should be included into dental radiology curriculum.

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