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Assessment of the knowledge and awareness in relation to CBCT among the medical practioners of Bhuj, Kutch, Gujarat- A cross sectional study

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Abstract

Background and Aim: The purpose of this study was to evaluate a specific medical community's knowledge and understanding of Cone-Beam Computed Tomography (CBCT) technology as well as awareness of the implications of CBCT use, including risk assessment. It is incumbent on the profession to understand how practitioners view this technology as it gains popularity and ease of use.

Materials and Methods: A 10-question survey was distributed to several different populations. The survey tried to gain understanding of practitioners' knowledge of radiation dosage related to CBCT, diagnostic usage, and explore ethical issues such as informed consent, clinical and diagnostic utility, and the influence of business and market forces on CBCT usage. Results were compiled and examined using non-parametric statistical tests (Independent Samples Kruskal-Wallis and Independent Samples Median) and post-hoc comparisons (Bonferroni, pairwise comparisons).

Results and Conclusions: Level of education in medicine, specialty training, years since completion of residency, age, and frequency of use of CBCT were all related to performance on Part 2 of the CBCT survey. Significant differences were noted among intergroup comparisons when evaluating the questions of the CBCT Survey. Technical, objective knowledge of CBCT is related to subjective, value judgments about CBCT implementation with patients.

Keywords: CBCT, Knowledge, Kruskal-Wallis, Radiation.

Introduction

Use of medical computed tomography (CT) radiographic imaging is increasing rapidly. A growing body of medical literature is linking increased low-dose exposure to ionizing radiation (such as diagnostic imaging) to a very small, but measurable, increased risk of mortality.(1) Although the advantages of this technology are varied and numerous, its risks to patients are poorly appreciated in the medical community as shown by several surveys of medical health professionals.(2) Some authors are calling for implementation of informed consent protocols for medical radiologic tests, especially the tests with higher doses and higher risk. In medical field, cone-beam computed tomography (CBCT) is becoming widely used in a variety of disciplines. The advantages it offers are also numerous. My review of the literature revealed no published papers that seek to evaluate medical practitioners' understanding of this new technology. Use of CBCT is likely to continue to increase as the technology becomes more user-friendly, less expensive, and better marketed. It is timely and appropriate to seek to understand the orthodontic profession's perception of the effect of CBCT on its patient population.(3)

CBCT offers numerous advantages compared to traditional 2D radiography, including a lack of superimposition, 1:1 measurements, the absence of geometric distortions, and 3D display. It is important to note that by utilizing a relatively low ionizing radiation, CBCT offers 3D representation of hard tissues with minimal soft tissue information. Conventional CT systems offer similar advantages (in addition to providing information about soft tissue); however, image acquisition requires much higher levels of ionizing radiation and a longer scanning time. In addition, the larger size of conventional CT units makes them poor alternatives for dental offices. 3D images acquired with CBCT have been used to investigate the exact location and extent of jaw pathologies and assess impacted or supernumerary teeth and the relationship of these teeth to vital structures. CBCT images are used for pre- and postsurgical assessment of bone graft recipient sites and to evaluate osteonecrosis changes of the jaws (such as those associated with bisphosphonates) and paranasal sinus pathology and/ or defect. CBCT technology has also been used for thorough pretreatment evaluations of patients with obstructive sleep apnea, to determine an appropriate surgical approach.(2,3,4)

Since the introduction of CT in the 1970's, its use in the medical field as a diagnostic tool has steadily increased. Current estimates indicate that more than 62 million scans are performed annually in the United States.(4) Some four million of these scans are for children.(2) Improvements in CT technology have made it easier to use in a wider variety of situations. For example, helical CT brings a faster scan and reduces the need to sedate children, which has contributed to an increase in the number of scans in younger patients. With image acquisition based on ionizing radiation, CT does not come without risks, however. Recent epidemiological studies have focused on the effects of low-dose radiation exposure over a lifetime.(5) Based on data from populations affected by the atomic bomb, these studies are able to show a definite degree of risk of

fatal cancer based on radiation exposure. The risks of radiation are not isolated to cancer, however. Impaired intellectual development and increased risk of cardiovascular disease are among the various other effects of radiation exposure.[5] Dosage values are reported a number of different ways. Effective dose (E), measured in Sieverts, is currently used. Effective dose is a term that "takes into account all of the irradiated organs and tissues, as well as their radio sensitivities." It is the best means of measuring how much radiation a patient receives during any radiologic examination. An effective dose of 10mSv (which is an 3 approximate dose for a single CT examination) can contribute to the radiation-induced deaths of 50 out of 100,000 people exposed, a mortality risk of 0.05%. Regression models of mortality risk generally show a linear increase in risk with increased dose. This model is well supported at doses over 100mSv. The epidemiological data to support extending the linear relationship below this dose is not clear.[6]

It is important to keep in mind that the risks associated with radiation in the dose range of diagnostic radiology are estimated; direct correlation with epidemiological data is not consistent.[7] However, it would seem prudent to assume there are risks at these lower doses, especially when children are involved. Children have a greater lifetime risk of developing fatal cancer due to low-dose radiation compared to adults due, in part, to a greater number of years over which those effects can be manifested. Effective radiation dose to children is about 50% more due to their smaller size. The lifetime risk does decrease with age. The aim of the present study was to estimate the knowledge and awareness related to the CBCT among the medical practioners in the city.

Materials & Methods

Present study was conducted at Department of radiology, Gujarat Adani Institute of Medical Science, Bhuj, Kutch, Gujarat. An online survey of 10 multiple-choice questions was distributed to general medical practioner and specialist doctors via email.(Table 1) The survey was developed after evaluating the referenced medical surveys for subject matter, formatting, number of questions, etc. This is a novel survey with questions created by the researchers to ascertain a basic knowledge level of CBCT as well as explore ethical and value judgment questions related to its use.

Total of 150 participants were contacted and the respondents were given four weeks to reply to the survey. Reminder emails were sent weekly to those who hadn't responded. A personal verbal appeal was made to all. Out of 110 general practioners 70 had responded and out of 40 specialist doctors 30 had responded back.(Table 2)

Table 1: Different Questions asked in relation to the knowledge of CBCT

Questions	Scale			
	Strongly agree	**Agree**	**Neutral**	**Disagree**
An informed consent discussion with patient regarding CBCT is necessary				
To discuss CBCT radiation exposure with patients				
Applications are consistent with the ALARA				
Clinical exam by the doctors should always precede other radiographs				
Is it important to avoid redundant radiographs				
Information from CBCT scans improves treatment outcomes				
CBCT use makes dentistry more profitable.				
Information from CBCT scans improves clinical diagnosis				
Rank imaging modalities in order of importance	CBCT	MRI	Ultrasound	CT
1 = Most Important, 4 = Least important				
Total				

Table 2: Survey populations, sample sizes, and response rates

Survey Population	Population size	Respondents	Response Rates
General Practioners	110	70	63.5%
Specialists Doctors	40	30	72.2%

Statistical tests used included Independent Samples Kruskal-Wallis Test and Independent Samples Median Test to identify differences between groups along with post-hoc pairwise comparisons and Bonferroni tests to isolate those differences.

Results

General response rates are shown in Table 2. Not all respondents completed the entire survey and not all respondents completely filled out the questions. Based on the distribution of the score availed by the medical practioners of the CBCT Survey, the participants were arbitrarily categorized into groups of good awareness (8-10score), average awareness (6–7 score), and poor awareness (0 5 score).(Table 3) General medical practioners were borderline adequate in their awareness level to CBCT. Current specialists were nearly all grouped in the good awareness. Based on the distribution of scores, we can conclude that the sample group of medical practioners are less aware as compared to the specialist in their level of CBCT knowledge.

Table 3: Scoring Category

Scores	Category
0 – 5	Poor Awareness
6 – 7	Average Awareness
8 – 10	Good Awareness

When the comparison was done between the two groups it was found out that only 10% of specialist doctors were poorly aware in the knowledge related to CBCT, as compared to 60% in the general practioners, whereas 60% of the specialist doctors were having sound knowledge in relation to the CBCT as compared to only 20% of the general practioners. (Table 4) The difference was found to be statistically significant. The average awareness percentage was nearly same in both the groups.

Table 4: Percentage of the participants scored in each group

Category	General Practioners	Specialist Doctors
Poor Awareness	60%	10%
Average Awareness	20%	30%
Good Awareness	20%	60%

Table 5: Scores assigned as per the scale of Importance

Scale of Importance	Scores
Strongly Agree	4
Agree	3
Disagree	2
Strongly Disagree	1

Table 5 demonstrates Scores assigned as per the scale of Importance. Doctors who gave the response as strongly agree score given was 4 and who gave the response strongly disagree score given was 1. Majority of general medical practioners had given disagree (score 2) response as per the scale of Importance of CBCT. In comparisons to general medical practioners, majority of specialist doctors gave strongly disagree response (score 4) and difference between them was found to be statistically significant ($p \leq 0.05$).

Discussion

The primary aim of this study was to determine the CBCT awareness level in general and specialist medical practioners. This study has sought to understand primarily what medical practioners know about CBCT, and secondarily what their opinions are on the implications of increased CBCT use in their discipline and dentistry in general. The scoring distribution in the CBCT survey approximated our expectations based on clinical and didactic experience.

Out of 30 specialist medical practioners 18 were MD (Medicine, Paediatrician, Skin) and 12 were MS (Surgery, Ortho). Specialist medical practioners in the program scored higher as compared to the general medical practioners. The results from the survey measured our intended metric, namely awareness of CBCT use in general medical practise. Arbitrary categories based on the received distribution allowed us to categorize good, average, and poor awareness for comparison. The answers to the CBCT survey were all quite different among the categories.[8] Reasons for this difference due to the less need for the CBCT by the general practioners as compared to the specialists. There is potential for more work to be done on this topic. There were significant differences among the good, average, and poor categories of the groups in their responses. However there were some interesting trends when the demographics of these three categories were compared. Those in the good awareness category**(n=19)** were younger, had graduated from residency more recently, and were more apt to be using CBCT on their patients more frequently. Those who had finished their residency**(n=11)** 10 years ago or less were trained in CBCT analysis and use. The good awareness category includes those who graduated less than 10 years ago from the field. A possible confounding variable for this finding include a sampling error or bias based on who chose to answer the survey (i.e., those who had more

experience and education with CBCT were more likely to complete the survey).

Education and knowledge of CBCT seem to inform the opinions reported. Although there were statistically significant differences among some groups, all groups had similar responses when asked about informed consent and discussing radiation dosage with patients. The utility of CBCT in diagnosis and improving treatment outcomes as well as profitability of CBCT was perceived differently by general practioners and specialists.[9] A disparity in understanding other imaging modalities and their relationship to between these groups as well. The data generated by the survey contain possibilities for additional analysis. The data supplied by this survey will allow further investigation into the validity of the questions, the ability to predict responses based on certain questions, and identification of trends based on demographic metrics such as age, education level, gender, ethnicity, overall and dental health, and others. A variety of other hypotheses and questions could be explored with these data.

One such line of further investigation could be related to informed consent. Specialist medical practioners tended to agree that informed consent was a necessary part of a CBCT survey. In light of the similarity 45 of convictions among all the samples, it would be telling to determine what the profession perceives the thresholds of risk to be for informed consent, if the risk from CBCT warrants a verbal and/or written informed consent, and to what extent the orthodontists who think informed consent is necessary are actually obtaining it prior to ordering CBCT surveys on their patients.[10]

Alternatively, specifically targeting a certain population will allow the refinement of questions based on that specific group. A challenge encountered in this study was creating a set of questions that were not too simple for the specialists and not too complex for the college graduate.[11] It may be impossible to create a survey with sensible technical questions that is understood by both oral and maxillofacial radiologists as well as patients, for example, with the disparity between levels of specialized education being so great. However, the ability to compare responses between various populations may be lost in this case.

Conclusion

Members of the profession should be clear on the implications of the technologies they decide to use on their patients, and how and why they choose to implement them. Such clarity can be estimated by a calibrated and widely circulated set of questions. It is also required that general medical practioners should be made aware regarding the usage of CBCT.

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