Awareness of Intraoral Scanners and Knowledge of Effects of Different Lights on the Accuracy of Intraoral Scanners Among Dental Students and Practitioners

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ABSTRACT

Digital dentistry is an emerging branch which aims on improving the efficiency of the outcome of the treatment. One of the newly used instruments which has gained a lot of popularity is an intraoral scanner. An intraoral scanner helps in recording digital impressions which overcomes the limitations of conventional impressions. Hence, it is important to increase the awareness about all the aspects of intraoral scanner to utilize it to its full potential. The objective of this study is to evaluate the knowledge and awareness of intraoral scanners and the effects of different lights on its accuracy among dentists. The present study was done among the dental practitioners and dental students in India. A questionnaire was made and given to the dentist to check their knowledge and awareness about intraoral scanners and the effects of different lights on its accuracy. It was found that most of the dental practitioners and dental students had knowledge about intraoral scanners but were not aware about the limitations and effects of different lights on the accuracy of intraoral scanners. The data obtained from the above study shows that the dentists are not aware of the effects of different lights on accuracy of different intraoral scanners and need to be educated on the same for obtaining better results.

KEY WORDS: INTRAORAL SCANNERS, LIGHT, ACCURACY.

INTRODUCTION

Digital dentistry is an emerging avenue in the field of dentistry. It refers to the use of digital technology and computer aided systems to carry out dental procedures in contrast to the manual methods (Neville and van der Zande, 2020). It is gaining popularity because of its accuracy and efficiency when compared with mechanical tools. The digital revolution has made a significant impact in changing the workflow which in turn affects the operating procedures (Mangano, Shibli and Fortin, 2016). The need of the hour is digitizing our work to obtain maximum efficiency (Kudva, 2016). There are different tools which have helped make digital dentistry an easier podium to work with. One such equipment is the use of intraoral scanners. Intraoral scanners (IOS) are devices for recording direct optical impressions in dentistry (Mangano et al., 2017). Like other three dimensional scanners, intraoral scanners project a light source onto

the object which has to be scanned (Zimmermann et al., 2015). It can be a dental arch, prepared tooth or scan bodies of implants (Martin et al., 2015). The images of the dentogingival system or the scan bodies are captured by the sensors and processed by the sensors in the form of point clouds. The cloud points are then analyzed by the software which makes it into 3D models (Imburgia et al., 2017).

Advantages of using optical impression with intraoral scanners
- Less discomfort for the patient(Means and Flenniken, 1970; Ahlholm et al., 2018)
- Time efficient(Yuzbasioglu et al., 2014; Burhardt et al., 2016)
- Better communication with the patient and dental technician(Kugel, 2014; Lawson and Burgess, 2015)
- No errors due to errors in cast pouring(Patzelt et al., 2014; Joda and Brägger, 2015)
- The procedure becomes simplified(Park et al., 2015; Lecocq, 2016)

Disadvantages of using optical impression with intraoral scanners
- Subgingival finish lines are difficult to detect(Mandelli et al., 2017; Lim et al., 2018)
- Costly and difficult to maintain(Aragón et al., 2016)

The main feature of an intraoral scanner is its accuracy (Goracci et al., 2016)(Chochlidakis et al., 2016). There are certain factors that affect the accuracy of the intraoral scanners (Patzelt et al., 2013; Rutkanas et al., 2017). Firstly, the saliva plays an important role in scanning with an intraoral scanner as it can wash away the spray particles and reduce the efficiency. Also, there can be some error in scanning as the saliva film created on the tooth will cause misreading of the object geometry (Kurz, Attin and Mehl, 2015). Secondly, the scanning protocol plays an influential role. Inadequate scanning leads to errors in the final prosthesis (Müller et al., 2016). Thirdly, the ambient light affects the coordinates measured by the intraoral scanner (Blanco et al., 2009). This survey was conducted to know about the awareness of intraoral scanners and the effects of different lights on the accuracy of intraoral scanners among dental practitioners and dental students.

MATERIAL AND METHODS

A questionnaire survey was conducted among different dental practitioners and dental students in India during January, 2020. The questionnaire was formulated in google forms. A total of 289 subjects were sent the questionnaire consisting of questions regarding the awareness about intraoral scanners and the effects of different lights on the accuracy of intraoral scanners out of which 117 subjects responded. Validation was done among post graduate students of the department of prosthodontics in XYZ Dental College. Ethical approval was obtained from the ethical board of XYZ Dental College. A simple random sampling was done. The survey was sent online to individuals and none were forced to fill the questionnaire. Guidelines followed as per the Helsinki declaration(Kemperman, 1982).

All the data was collected in Google sheets and analyzed using SPSS 21 (SPSS Inc., Chicago, IL). Chi square test was done to statistically analyze the data and visual representations of the data were plotted with the extracted data. The independent variables in this survey would be sex of the subject, the intraoral scanner used and the light used while using the scanner. The dependent variable in this survey would be the age and experience of the subject.

RESULTS AND DISCUSSION

As the application of digital models has broadened into many areas, the accuracy of 3D images acquired on an intraoral scanner has become an important topic in research (Auskalnis et al., 2019). Accuracy refers to precision and trueness of the object (Chandran et al., 2010). Hence it is important to adjust all the factors influencing the accuracy of intraoral scanners to maximize the effect. Ambient light has a great impact on the accuracy of the intraoral scanner (Revilla-León et al., 2020). Several in vitro studies have demonstrated the effect of ambient light on the accuracy of different intraoral scanners (Revilla-León et al., 2019a, 2019b). Based on these reports, a scanning accuracy difference of 37%-44% can be seen when under different light conditions(Revilla-León et al., 2019a).

A total of 289 subjects were sent the questionnaire out of which 117 subjects responded. Out of the 117 subjects, 70 (59.8%) were females and 37 (40.2%) were males. The mean age range of the study subjects were from 18 to 75 years. Out of the 117 responses, 35.5% were post graduate other than prosthodontics, 31.6% were general practitioners, 22.8% were prosthodontics postgraduate, 8.5% students were undergraduate students and remaining were prosthodontist). Out of the 117 responses, 70.0% were aware about the use of intraoral scanners, 20.0% were not aware about the use of intraoral scanners and 10.0% were aware about intraoral scanners to some extent (Figure 1). Out of 117 responses, 83 (70.1%) were not aware about the effects of different lights on the accuracy of intraoral scanners, 25 (21.4%) were aware about the effects of different lights on the accuracy of intraoral scanners to some extent whereas only 9 (7.7%) were aware about the effects of different lights on the accuracy of intraoral scanners (Figure 10). There was a statistically significant difference in the responses of the questions with respect to the practitioner groups (p<0.05).

In the current survey, most of the dental students and dental practitioners were aware about intraoral scanners (Figure 4), its indications (Figure 5) and its limitations (Figure 6). Now, when digital dentistry is taking over, it

is important for all dentists to be well versed with the latest equipment and techniques. More than half of the dentists, who were given the questionnaire do not use intraoral scanners in their clinical practice (Figure 7). With the use of intraoral scanners, the workload becomes quite dwindled. Hence, more number of clinicians should use intraoral scanners to reduce the workload and increase the efficiency. More than half of the dentists, who were given the questionnaire were not aware about the effects of different lights on the accuracy of intraoral scanners. Without proper knowledge, using any equipment can lead to errors and hence can negatively impact the results. Each scanner has its own advantages and disadvantages which a clinician should be aware of before using them. One of them is the effect of different lights on the accuracy of intraoral scanners. It is important to know about all the factors to maximize the potential of the system.

Table 1. Showing the correlation between different groups of dental practitioners and the awareness about intraoral scanners.

Questions	Options	Which practitioner group do you belong to?					Cumulative response percent	Chi square value	P value
		UG Students	PG Students (Prosthodontics)	PG Students (Other Departments)	General practitioner	Prosthodontist			
Are you aware about intraoral scanners?	No	70.0%	0.0%	22.0%	21.6%	0.0%	20.5%	27.094	0.001*
	To some extent	10.0%	3.8%	14.6%	8.1%	0.0%	9.4%		
	Yes	20.0%	96.2%	63.4%	70.3%	100.0%	70.1%		
Are you aware about the indications of intraoral scanners?	No	70.0%	0.0%	24.4%	18.9%	0.0%	20.5%	37.961	0.001*
	To some extent	30.0%	50.0%	43.9%	73.0%	33.3%	53.0%		
	Yes	0.0%	50.0%	31.7%	8.1%	66.7%	26.5%		
Are you aware about the limitations of intraoral scanners?	No	70.0%	3.8%	34.1%	21.6%	0.0%	25.6%	39.302	0.001*
	To some extent	30.0%	50.0%	43.9%	75.7%	33.3%	53.8%		
	Yes	0.0%	46.2%	22.0%	2.7%	66.7%	20.5%		
Do you use intraoral scanners in your clinical practice?	No	80.0%	15.4%	75.6%	48.6%	0.0%	52.1%	32.753	0.001*
	Sometimes	10.0%	23.1%	12.2%	8.1%	33.3%	13.7%		
	Yes	10.0%	61.5%	12.2%	43.2%	66.7%	34.2%		
Which intraoral scanner do you use?	None	70.0%	5.0%	60.0%	35.1%	0.0%	40.9%	45.596	0.001*
	I Tero Element	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%		
	CEREC	30.0%	60.0%	25.0%	62.2%	100.0%	46.4%		
	Trios	0.0%	25.0%	2.5%	2.7%	0.0%	6.4%		
	EzScan	0.0%	0.0%	2.5%	0.0%	0.0%	0.9%		
	Aoralscan	0.0%	0.0%	5.0%	0.0%	0.0%	1.8%		
	Others	0.0%	10.0%	5.0%	0.0%	0.0%	3.6%		
Which light do you use while scanning with the intraoral scanner?	No light	66.7%	21.1%	36.1%	18.9%	0.0%	29.1%	40.566	0.001*
	Sunlight	33.3%	31.6%	16.7%	64.9%	100.0%	0.0%		
	Tubelight	0.0%	15.8%	8.3%	16.2%	0.0%	39.8%		
	Chairside light	0.0%	31.6%	38.9%	0.0%	11.7%	19.4%		
Do you know the effects of different lights on intraoral scanners?	No	90.0%	50.0%	73.2%	81.1%	33.3%	70.9%	12.870	0.116
	To some extent	10.0%	38.5%	19.5%	13.5%	33.3%	21.4%		
	Yes	0.0%	11.5%	7.3%	5.4%	33.3%	7.7%		

Continue Table

Are you aware about the unit in which the intensity of light is measured?	No	90.0%	57.7%	56.1%	91.9%	33.3%	70.1%	17.947	0.001*
	Yes	10.0%	42.3%	43.9%	8.1%	66.7%	29.9%		

Figure 1: Bar graph representing the association between awareness about intraoral scanners and the practitioner group.
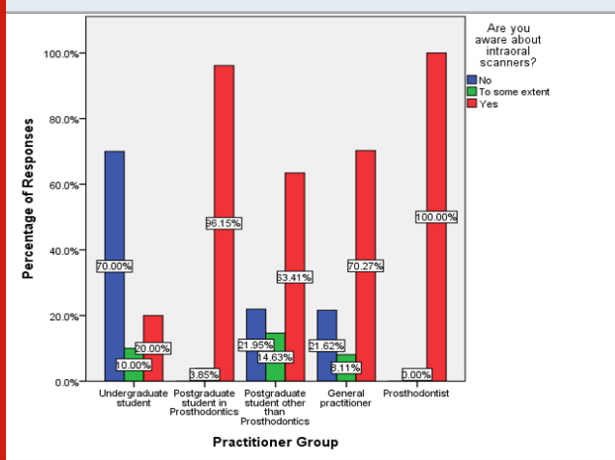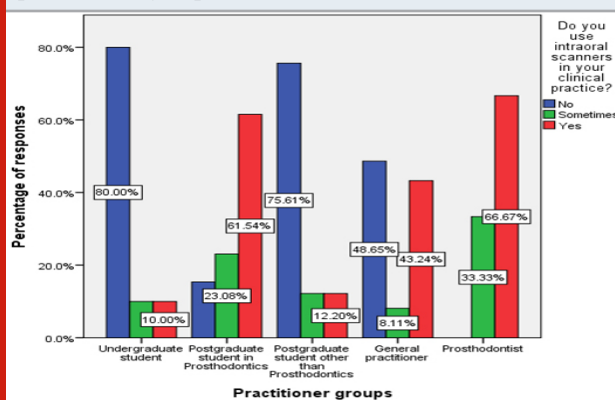

Figure 2: Bar graph representing association between usage of intraoral scanners in clinical practice and practitioner groups


In one study, it showed that iTero Element, using chair and room light conditions resulted in better accuracy, whereas, for CEREC Omnicam, zero light resulted in better accuracy and for TRIOS 3, room light gave the best accuracy(Revilla-León et al., 2019a). In a similar study by Arakida et al(Arakida et al., 2018), they concluded that the most accurate results with a high-accuracy noncontact three-dimensional coordinate measuring machine like Infinite focus G5 was seen with 500 lux and 2500 lux of light. The 500 lux condition represents the illumination by a room light in a clinic, while the 2500 lux condition represents the illumination by a dental unit light(Viohl, 1979). Clinicians should understand the ambient lighting condition as a critical influencing factor on the scanning accuracy of IOSs, and a light

meter should be included into the armamentarium of the digital device.

Although this study gives adequate information on the awareness regarding the intraoral scanners, there are limitations to the study. The major limitation is that the number of people who responded were very less. Additional studies are needed to fully understand the impact of lighting conditions on the accuracy of the available intraoral digitizer systems.

Figure 3: Bar graph representing the association between awareness of effects of different lights on intraoral scanners and practitioner groups.
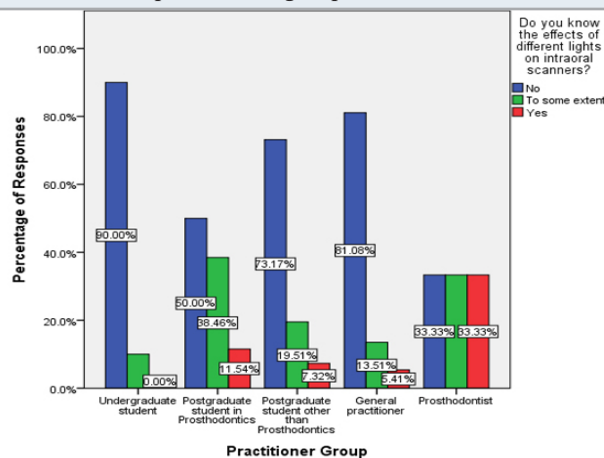
CONCLUSION

The data obtained from the above study shows that the dentists, mostly the undergraduate students and postgraduate students other than prosthodontics are not aware of the effects of different lights on accuracy of different intraoral scanners. It is very important for dental practitioners and students to know this as it can affect the outcome of the final prosthesis. The dental students and practitioners should be educated about the different aspects of intraoral scanners so that they can harness the full potential of intraoral scanners with minimum errors. The undergraduate and postgraduate students should be taught about the latest equipment and their proper use in their curriculum and there should be more lectures and seminars by the speakers for increasing the awareness about the proper use of latest techniques and equipment among the dental practitioners. More webinars and online lectures should be conducted for dental practitioners who are not able to attend the seminars. Critical analysis of the topic and panel discussion should be arranged for better understanding of the topic. After any lecture taken in

a conference, a written questionnaire should be given to the audience to verify their understanding about the topic of the lecture. More frequent surveys should be circulated in the colleges to increase the awareness among the students.

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APPENDIX
Questions asked

1. Name
2. Sex
3. Age
4. Which of the practitioner groups you belong to?
5. Are you aware about intraoral scanners?
6. Are you aware about the indications of intraoral scanners?
7. Are you aware about the limitations of intraoral scanners?
8. Do you use intraoral scanners in your clinical practice?
9. Which intraoral scanner do you use?
10. Which light do you use while scanning with the intraoral scanner?
11. Do you know the effects of different lights on intraoral scanners?
12. Are you aware about the unit in which the intensity of light is measured?