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Ability of digital imaging in diagnosing periapical lesions at varying brightness and resolution

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Abstract

Aim: To evaluate the radiographic appearance of periapical lesions in intraoral digital radiographs by observing them in two different displays, i.e. In Laptop and Smartphones with maximum and minimum brightnessand as compressed images in laptop.**Materials and methods:** The retrospective study with sample size of 40 digital radiographs with periapical lesion on left mandibular molars were selected. The radiographs were assessed by 3 expert Oral Radiologists for presence and extension of the periapical lesion using two different displays (laptops, smartphones) with extremebrightness (low, high) and different image resolutions.**Results:** One way ANOVA was applied to compare the mean values. Tukey post hoc test was used to compare pair-wise distribution among the variables. Descriptive statistics was used to analyse the mean of variables used in the study. The *p-value <0.05*was considered as significant.**Conclusion:**Classic traditional methods have been replaced for the convenience by the practitioner. So, the study proves that modern technologies can come in handy for diagnosis.

Keywords: 1. Periapical lesion 2. Digital Imaging 3. Display devices 4. Image Resolution

Introduction

X-Rays were discovered by Roentgen in 1895 while he was experimenting with cathode rays[1]. Followingly, fourteen days after his publication, the first picture of teeth was attempted by Dr.Otto Walkohoff[2] which turned out to be successful. Since then, x-rays have become a normal part of routine clinical practice. Radiographic investigations have become mandatory to conclude the clinical diagnosis and proceed with treatment plan.

X-rays can be broadly classified as conventional and digital. One of the digital imaging systemsis Radiovisiography (RVG), which in spite of various limitations promised to have various clinical applications[3-4]. Over the advancing years, thistechnology offers many advantages over conventional radiography, as it eliminates the need for films and its processing. The mean radiation dosage is 22.3% of that of conventional radiographs and in turn provides a low radiation exposure[5]. Moreover, the generated image is available for the interpretation avoiding the hazzles of developer and fixer solutions. The digital display has an added value to help in the enhancement of image for viewing. Digital imaging is less time consuming, requires less exposure and reduces hazardous waste materials that could be generated in traditionalfilm imaging. Digital imaging can be stored in various formats, can be viewed in different display systems and lighting.

The resolution and image characteristics can be altered by the operator using software, to improve the diagnostic efficiency. So, there is possibility that always the proper display systems or room lighting or resolutions may not be available. Hence the present study was undertaken to determine the diagnostic efficacy in radiographic interpretation of periapical lesions on digital radiographs with different room lighting, resolution and image display devices.

Materials and methods

40 digital periapical images were selected retrospectively from the database of radiology centre in Oral Medicine department.Digital radiographs (DIGORA® Optime, Soredex, Milwaukee, WI) were obtained by parallel technique in a standardized projection geometry of the set blocks, image receptor and X-ray tube extension. The X-ray machine was operated at 60 kVp, 10 mA, 0.12 s, 40 cm distance from receptor to target, with filtration at 2 mm of Al.

The study included both male and female of age group 25 to 40 years with periapical lesion and excluded radiographs with completely edentulous ridges, radiographs without periapical lesionsand radiographs without complete apical coverage.

The study protocol was proposed and approved by the Institutional Review Board of SRM Dental college, Ramapuram. The study was carried out in the months of December 2019 and January 2020.

Among the collected data of digital radiographs, 40 images with periapical lesions in lower molars were scrutinized. The selected images were transferred to Laptop with 15.6 inches display screen and mobile phone with 6.01 inches display screen. The images were also compressed for about 55% of the initial pixel resolution and viewed on laptop with 15.6 inches display screen.

Smartphones with 640X960 pixels were used with 6.01-inch display screen. Laptop specification was 1920X1080 pixels in 12-inch length of the monitor. They were viewed and evaluated for the presence and extension of the lesion in two different display devices with two different brightness, low at 0 and high at 100 respectively with altered resolution.

The RVG's were assessed by 3 certified Oral Medicine and Radiology expertise. The assessment is based on the presence and extension of the periapical lesion.They were evaluated for the presence of periapical lesion by observing them in two different displays, i.e. In Laptop and Smartphones with maximum and minimum brightness. The images were compressed to 55% of its original resolution and viewed in laptop with high (100) and low (0) brightness.Likert'spsychometric scale[6]was used for evaluation of images by experts using the following criteria: 1- poor diagnosis, 2- moderate diagnosis, 3 - good diagnosis, 4 - perfect diagnosis.

Statistical analysis

To analyse the data, parametric testswasused. One way ANOVA was applied to compare the mean values. Tukey post hoc test was used to compare pair-wise distribution among the variables. To analyse the data SPSS (IBM SPSS Statistics for Windows, Version 26.0, Armonk, NY: IBM Corp. Released 2019) was used. Significance level was fixed at 5% ($\alpha = 0.05$). *p-value <0.05* is considered to be statistically significant.The Normality tests, Kolmogorov-Smirnov and Shapiro-Wilks tests results revealed that the study followed normal distribution.

Results

Table 1 shows the descriptive statistics based on image resolution. The mean was found to be higher in high brightness resolution (3.47) when compared to low brightnessresolution (3.15). Table 2 shows the descriptive statistics based on laptop image. The mean was found to be higher in highbrightness (3.62) when compared to low brightness (3.42). Table 3 shows the descriptive statistics based on mobile image. The mean was found to be higher in highbrightness (3.82) when compared to low brightness (3.40). Table 4 shows comparison at high brightnessamong resolution, laptop and mobile using One way ANOVA. The p-value <0.05 was obtained which implies that statistically significant differences were seen among the study variables. Table 5 shows pair-wise comparison of mean difference among the high brightness based on resolution, laptop and mobile using tukey post hoc test. The p-value was found to be <0.05 for high brightnessmobile which implies that statistically significant difference was found went compared among the other study variable. Table 6 shows comparison of mean difference among the lowbrightnessbased on resolution, laptop and mobile using one way ANOVA. The p-value >0.05 was obtained which implies that no statistically significant differences were seen among the study variables. Table 7 shows pair-wise comparison of mean difference among the high brightness

based on resolution, laptop and mobile using tukey post hoc test. The p-value was found to be >0.05 for all the variables which implies that no statistically significant difference was among the study variable. Graph 1 shows comparison of mean difference among the high and low image based on resolution, laptop and mobile. The mean was found to be higher in high brightness image of mobile followed by high brightness image of laptop and least quality was found in low brightness image of mobile.

Table 1: Comparison of mean difference using one way ANOVA at high brightness among based on resolution, laptop and mobile

ANOVA

	Sum of Squares	Df	Mean Square	F	P-value
Between Groups	2.467	2	1.233	4.356	.015*
Within Groups	33.125	117	.283		
Total	35.592	119			

Table 2: Pair-wise comparison of mean difference using Tukey Post Hoctest at high brightnessbased on resolution, laptop and mobile

Multiple Comparisons

Tukey HSD

Variables		Mean Difference (I-J)	Std. Error	P-value	95% Confidence Interval	
					Lower Bound	Upper Bound
RESOLUTION IMAGE	HIGH	-.15000	.11898	.420	-.4324	.1324
	LOW	-.35000*	.11898	.011*	-.6324	-.0676
LAPTOP IMAGE	HIGH	.15000	.11898	.420	-.1324	.4324
	LOW	-.20000	.11898	.217	-.4824	.0824
MOBILE IMAGE	HIGH	.35000*	.11898	.011*	.0676	.6324
	LOW	.20000	.11898	.217	-.0824	.4824

Table 3: Comparison of mean difference using one way ANOVA at low brightnessbased on resolution, laptop and mobile

ANOVA

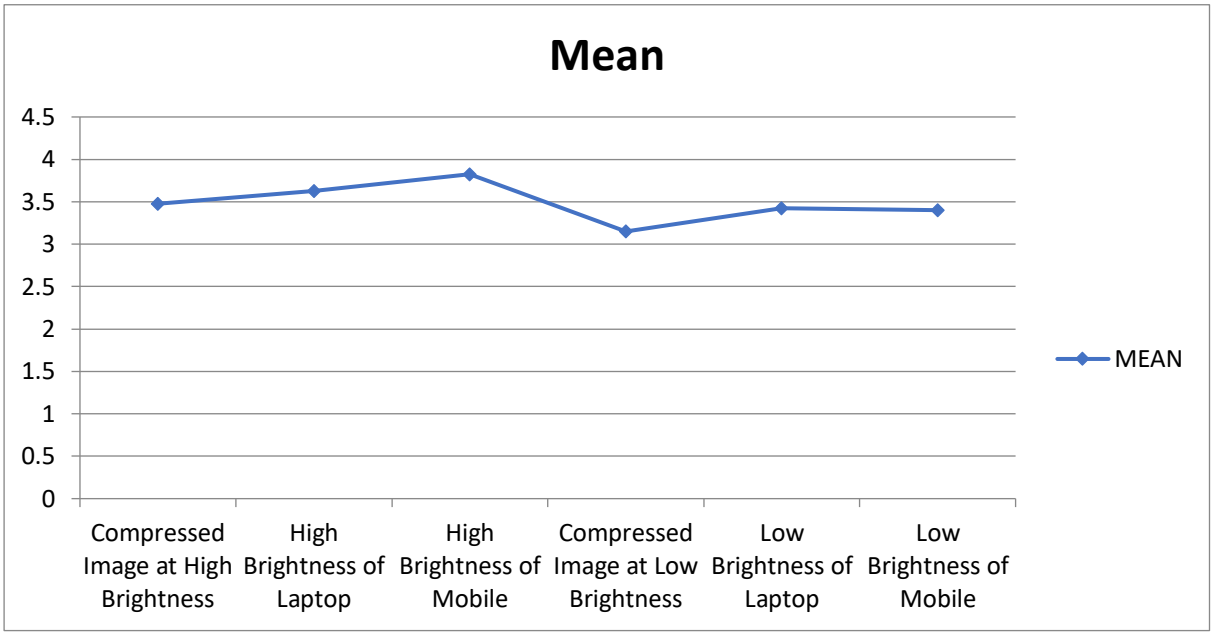
	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	1.850	2	.925	2.548	.083
Within Groups	42.475	117	.363		
Total	44.325	119			

Table 4: Pair-wise comparison of mean difference using Tukey Post Hoc test at the low brightnessbased on resolution, laptop and mobile

Multiple Comparisons

Variables		Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
RESOLUTION	HIGH	-.27500	.13473	.107	-.5948	.0448
	LOW	-.25000	.13473	.156	-.5698	.0698
LAPTOP	HIGH	.27500	.13473	.107	-.0448	.5948
	LOW	.02500	.13473	.981	-.2948	.3448
MOBILE	HIGH	.25000	.13473	.156	-.0698	.5698
	LOW	-.02500	.13473	.981	-.3448	.2948

Graph 1: Comparison of mean difference among the high and low brightnessbased on resolution, laptop and mobile



The results of present study showed that high brightness of mobile was significantly (p value <0.05) better compared to other images used in the study. The diagnostic quality was notably better at high brightness ofmobile phone, laptop andcompressed images when compared to low brightness. While assessing diagnostic quality, laptop images was remarkably better (p value >0.05) at low brightness as when compared with other two category of images. In assessing the one-way ANOVA test for high brightness, the mean difference was statistically significant whereas the mean difference was not statistically significant in low brightness. While assessing the pair-wise comparison, high brightness mobile image was found to be far better than other study groups. The study results clearly showed that at high brightness, mobile was found to be effective.

Discussion

This retrospective analysis aimed to evaluate Periapical lesions in digital images with extreme brightness conditions (0 and 100) in mobile and laptop along with compressed resolution of the original digital images. Radiographic investigations have been a key factor in diagnosis ever since x-rays were discovered. The evolution of science and technologies has changed from conventional analogue imaging to digital techniques. Digital imaging data becomes easily shareable to

either patients or dentists. While transferring such documents there are possibilities of viewing the document in different brightness of the device that can either be laptop or mobile phones. In case of transfer between devices through certain apps, the images are compressed which can affect the quality. The same images were viewed in two devices (mobile and laptop) with two different lighting (High and low) and with 55% compressed file in normal brightness. Compressed image allows many images to be stored in a given memory space and also, they are easily transferable, consuming less time. Compressed images do not degrade the quality of the image to an unacceptable level but they are frequently used in diagnostic radiology. Hence it is necessary to assess its performances.

The uniqueness in our methodology as compared with previous literature is that none of the study have evaluated periapical lesions at both the extreme brightness conditions (0 and 100). It is also the first one to determine the diagnostic efficacy in compressed images.

The freedom of evaluation without focusing on standardizing room lighting was essential target of the study to help in determining the feasibility of the study in future, as most of the dental offices work with varying room lights[7-9]. Moreover, there were various practical difficulties in having a standard lighting, hence in this study providing standardized room lighting facility during interpretation of radiographs was not considered.

In order to overcome the challenges that could arise as a result of positioning errors Position Indicating Device were used and also exposure parameters were standardized by tube voltage at 60kV, tube current at 1 mA with exposure time of 0.02 seconds. In order to eliminate discrepancies that may arise as a result of age and anatomic variation of a particular site, age limit of 25 to 40 years with mandibular left posteriors were considered to detour anatomic variation. Literature reveals that the experience of dental practitioner is vital than the display units and viewing conditions. Hence 3 experts with 10 years of expertise in the field were recruited for evaluation of images.

Our study reveals better diagnostic efficacy in mobile phones at high brightness without the application of zoom - in tool. This can in turn help in the better evaluation of diagnosis when used in day-to-day practices. Mobiles can be handy[10], convenient in data sharing and easy to carry and access.Our study is in accordance to Kazuyaki et al., which compared DICOM compatible personal computer (PC) and a normal PC with tablet. It was found that the PC showed a lower accuracy when compared to the other groups[11]. Kallioet al., in his study concludes that all display devices were significant on evaluation by experienced professionals whereasfreshers found it little difficult for evaluation[12-13]. Evaluation of compressed images wasa key factor in our study becausetransferred data can have compromised resolution. Our study being one

of a kind in evaluating periapical lesions at extreme and low brightness and in compressed images showed that compressed images when viewed at high brightness, have good diagnostic efficacy. At high brightness pathologies that could be missed can also be evaluated irrespective of the resolution.

Conclusion

In recent trend conventional analogue imaging has been increasingly replaced by digital imaging[14] for the convenience of the practitioners.Mobile phone can be handy and very convenient for all the clinician to diagnose disease more accurately and our study recommends that mobile phones at high brightness have a remarkably good diagnostic quality even when the images are compressed.

Conflict of interest

Nil.

References

1. *Assmus A. Early history of X rays. Beam Line. 1995;25(2):10-24.*
2. *Forrai J. History of x-ray in dentistry. Revista de clínica e pesquisa odontológica-journal of dental clinics and research. 2007;3(3):205-11.*
3. *Mouyen F, Benz C, Sonnabend E, Lodter JP. Presentation and physical evaluation of RadioVisioGraphy. Oral Surgery, Oral Medicine, Oral Pathology. 1989 Aug 1;68(2):238-42.*
4. *Horner K, Shearer AC, Walker A, Wilson NH. Radiovisiography: an initial evaluation. British dental journal. 1990 Mar;168(6):244-8.*
5. *Soh G, Loh FC, Chong YH. Radiation dosage of a dental imaging system. Quintessence International. 1993 Mar 1;24(3).*
6. *Joshi A, Kale S, Chandel S, Pal DK. Likert scale: Explored and explained. Current Journal of Applied Science and Technology. 2015 Feb 20:396-403.*
7. *Cruz AD, Castro MC, Aguiar MF, Guimarães LS, Gomes CC. Impact of room lighting and image display device in the radiographic appearances of the endodontic treatments. Dentomaxillofacial Radiology. 2018 Jul;47(5):20170372.*

8. *Nascimento EH, Gaêta-Araujo H, Vasconcelos KF, Freire BB, Oliveira-Santos C, Haiter-Neto F, Freitas DQ. Influence of brightness and contrast adjustments on the diagnosis of proximal caries lesions. Dentomaxillofacial Radiology. 2018 Dec;47(8):20180100.*
9. *Orafi I, Worthington HV, Qualtrough AJ, Rushton VE. The impact of different viewing conditions on radiological file and working length measurement. International endodontic journal. 2010 Jul;43(7):600-7.*
10. *Araki K, Fujikura M, Sano T. Effect of display monitor devices on intra-oral radiographic caries diagnosis. Clinical oral investigations. 2015 Nov;19(8):1875-9.*
11. *Kallio-Pulkkinen S, Haapea M, Liukkonen E, Huumonen S, Tervonen O, Nieminen MT. Comparison of consumer grade, tablet and 6MP-displays: observer performance in detection of anatomical and pathological structures in panoramic radiographs. Oral surgery, oral medicine, oral pathology and oral radiology. 2014 Jul 1;118(1):135-41.*
12. *Kallio-Pulkkinen S, Huumonen S, Haapea M, Liukkonen E, Sipola A, Tervonen O, Nieminen MT. Effect of display type, DICOM calibration and room illuminance in bitewing radiographs. Dentomaxillofacial Radiology. 2016 Jan;45(1):20150129.*
13. *Tadinada A, Mahdian M, Sheth S, Chandhoke TK, Gopalakrishna A, Potluri A, Yadav S. The reliability of tablet computers in depicting maxillofacial radiographic landmarks. Imaging science in dentistry. 2015 Sep;45(3):175.*
14. *Straus MD. Now You See It, Now You Don't: Visual Illusions in Radiology1. RadioGraphics. 2013;33:2087-102.*