RESEARCH PAPER

INFLUENCE OF AGE AND GENDER ON GRAY SCALE VALUE OF MAXILLARY SECOND MOLAR - CBCT ANALYSIS

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ABSTRACT

BACKGROUND: Dental caries lead to the destruction of tooth structures due to the interaction of bacteria and fermentable carbohydrates. Grayscale is a measure of intensity which helps in monitoring the progression of white spot lesions on a tooth by quantifying the grayscale difference between the white spot lesions and the surrounding healthy enamel in the blue channel of a digital color image of the tooth.

AIM: The aim of the present study was to analyze the influence of age and gender on the gray scale value of maxillary second molar using CBCT.

MATERIALS AND METHOD: The study examined 25 CBCT samples within the age group of 20 to 50 years. The gray scale values of the samples were analyzed using the RadiAnt DICOM viewer software. The values were recorded in the longitudinal section of the maxillary second molar tooth at various points. It includes 1 occlusal, 2 proximal points on the enamel, dentino enamel junction (DEJ) and coronal dentin; 2 proximal points on the cemento enamel junction (CEJ); coronal, middle and apical points on the root dentin. The mean grayscale values were assessed.

RESULT: The gray scale values of enamel was in the range of 2222.24 to 2233.6, DEJ were between 1521.44 and 1530.84, coronal dentin was in the range of 1230.68 to 1343.36 and the values of CEJ and root dentin were 884.88 to 907.32 and 1213.4 to 1263.64.

CONCLUSION: The mean grayscale values were greater for male than females and increased values were observed among the individuals of 20-30 years.

KEYWORDS: CBCT, DICOM, Grayscale, Maxillary second molar, Innovation, Good health, Oral disease.

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INTRODUCTION

Dental caries lead to the destruction of tooth structures due to the interaction of bacteria and fermentable carbohydrates. (1) It is a prevalent and multifactorial disease that affects individuals of all age groups and it is one of the most important public health challenges faced worldwide. (2) According to recent research 60–90% of children and nearly 100% of adults have dental cavities, most commonly leading to pain and discomfort. Dental caries is also associated with the amount, type and frequency of sugar intake. The progress of these dental caries occur slowly in most people resulting in an imbalance between oral biofilm and tooth minerals. (3)This imbalance is characterized by increased microbial activity, changes in plaque pH due to bacterial acid production and buffering action from saliva. The presence of acid producing bacteria in the case of dental caries plays a key role in the dissolution of tooth structures.(4) X-ray analysis was considered as a golden standard for the diagnosis of dental caries; however, it is difficult to diagnose its early stage or tooth demineralization using this method. (5)

Cone beam computed tomography (CBCT) is a new application of CT that generates 3D data at affordable costs than conventional "fan beam" CT. Data from the craniofacial region are often collected at higher resolution in the axial plane using CBCT than those from conventional CT systems.(6) CBCT offers more accurate visualisation of anatomical details making it invaluable in clinical practice.(7) Although most of the CBCT usage has been confined to the placement of dental implant, orthodontics, surgery, and temporomandibular joint disease (8), several studies on the diagnosis of dental caries have also been reported. CBCT is a non-invasive method for age assessment. (9) The use of CBCT in dental practice offers a number of advantages over conventional tomography which include easier image acquisition, higher image accuracy, lower effective radiation doses, faster scan times, and greater cost-effectiveness.(10,11)

The grayscale value (GSV) is a number that represents the amount of X ray beam attenuation by the material contained in each structural unit of the tomographic volume or voxel. Digital color images are made of pixels. (12) A pixel is the smallest controllable element of a digital picture which is made of combinations of primary colors represented by a series of codes. Grayscale is a measure of intensity which helps in monitoring the progression of white spot lesions on a tooth by quantifying the grayscale difference between the white spot lesions and the surrounding healthy enamel in the blue channel of a digital color image of the tooth. (13) The aim of the present study is to analyze the influence of age and gender on the gray scale value of maxillary second molar using CBCT.

MATERIALS AND METHOD

The present study was conducted in the Department of Conservative dentistry and Endodontics, Saveetha Dental College, Chennai. The study examined 25 CBCT samples within the age group of 20 to 50 years. The gray scale values of the samples were analyzed using the RadiAnt dicom viewer software. The values were recorded in the longitudinal section of the tooth at various points. It includes 1 occlusal, 2 proximal points on the enamel, dentino enamel junction (DEJ) and coronal dentin; 2 proximal points on the cemento enamel junction (CEJ); coronal, middle and apical points on the root dentin. The values were recorded in the microsoft excel sheet. The differences in the mean grayscale values among male and female gender and the individuals of different age groups were analyzed.

RESULTS

The mean gray scale values were recorded and it was compared with age and gender. The mean gray scale values recorded at the various points are depicted in Table 1. The gray scale values of enamel was in the range of 2222.24 to 2233.6, DEJ were between 1521.44 and 1530.84, coronal dentin was in the range of 1230.68 to 1343.36 and the values of CEJ and root dentin were 884.88 to 907.32 and 1213.4 to 1263.64 The differences of the grayscale values among male and female gender is represented in Table 2. It represents that the gray scale values were comparatively higher for male at the points on enamel, coronal dentin and root dentin. However the values were greater for females at the points on the DEJ and CEJ. The differences in the grayscale values among different age groups were represented in Table 3. The gray scale value of enamel was greater for the individuals belonging to 20 to 29 years of age. The values of DEJ, coronal dentin were greater in the age group of 30 to 39 years. The gray scale values on CEJ and root dentin were higher among the individuals belonging to the age group of 40 to 49 years.

Table 1: Represents the mean gray scale value at various points of maxillary second molar included in the study based on CBCT analysis.

	POINTS	GRAYSCALE VALUE
	Incisal	2233.6
ENAMEL	Mesial	2232.72
	Distal	2222.24
	Incisal	1527.88
DEJ	Mesial	1530.84
	Distal	1521.44
	Incisal	1230.68
CORONAL DENTIN	Mesial	1332.2
	Distal	1343.36
	Mesial	907.32
CEJ	Distal	884.88
	Coronal	1263.64
ROOT DENTIN	Middle	1223.96
	Apical	1213.4

Table 2: Represents the difference in the grayscale values at various points of maxillary second molar among male and female gender based on CBCT analysis.

		Male	Female
	Incisal	2252.45	2218.78
ENAMEL	Mesial	2244.45	2223.5
	Distal	2209.45	2232.28
	Incisal	1523.81	1531.07
DEJ	Mesial	1515.54	1542.85
	Distal	1506.54	1533.14
	Incisal	1245.09	1219.35
CORONAL DENTIN	Mesial	1365.36	1306.14
	Distal	1352.63	1336.07
	Mesial	905.90	908.42
CEJ	Distal	881.90	887.21
	Coronal	1263.81	1263.5
ROOT DENTIN	Middle	1234.27	1215.85
	Apical	1212.90	1213.78

Table 3: Represents the differences in the grayscale values at various points of maxillary second

		20-29 years	30-39 years	40-49 years
	Incisal	2231.37	2237.5	2231.11
ENAMEL	Mesial	2248.12	2228.25	2223
	Distal	2243.62	2201	2222.11
	Incisal	1524.75	1566.25	1496.55
DEJ	Mesial	1518.5	1586.25	1492.55
	Distal	1506.62	1569	1492.33
	Incisal	1210.87	1268.25	1214.88
CORONAL DENTIN	Mesial	1328.87	1355.25	1314.66
	Distal	1315.75	1380.5	1334.88
	Mesial	894.75	901.87	923.33
CEJ	Distal	872.62	881.75	898.55
	Coronal	1241.37	1281.5	1267.55
ROOT DENTIN	Middle	1243	1196.87	1231.11
	Apical	1186	1200.75	1249

molar among different age groups based on CBCT analysis.

DISCUSSION

From the results of the present study, it is found that the gray scale values for the majority of the parameters were greater for male than females. Similarly, the gray scale values of enamel were the highest among the individuals belonging to 20-29 years of age. Digital radiographic methods such as grayscale analysis plays a key role in the diagnosis of caries especially in the proximal areas due to the dentist's limited visibility of caries present in these areas. (14,15) From the results of the study conducted by (16), it was proved that grayscale analysis of CBCT was more accurate than the conventional intraoral radiographs for the diagnosis of cysts and tumors.

From the results of (17), it was found that the grayscale value in the area of lesion was lower compared to that of sound enamel. This indicates the effectiveness of grayscale value analysis in the detection of enamel caries. The study conducted by Stroud et al., concluded that the thickness of the enamel showed no significant sex differences which contradicted the results of the present study where the enamel mineralization was greater in male than female. The results of Stroud et al., also concluded that the thickness of dentin was greater in male than female which is in accordance with the results of the present study. (18)

From the results of the study conducted by Emadi N et al., it was found that the gray scale values obtained from CBCT greatly depends on the CBCT unit and the various imaging parameters used.(19) Gray value measurements in CBCT was influenced by several factors such as the field of view (FOV), the selected region of interest (ROI) and also varied depending on the position of object within the scanning field. (20)

The results of the study conducted by (21) proved that the sensitivity to grayscale contrast diminishes with age and it plays a key role in the grayscale perception by dental practitioners. The values of the grayscale level aids in detecting small alterations in the surface of the enamel. The value was lower for the images of teeth subjected to demineralization than the images of healthy or remineralized teeth. (22) The major limitation of the present study is the small sample size. In future a similar study can be conducted with larger samples for better and accurate results.

CONCLUSION

The grayscale values of the majority of the parameters were greater for male than female and younger individuals had increased values than older individuals. The grayscale value plays a key role in detecting small lesions on dental hard tissues.

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CONFLICT OF INTEREST

The authors hereby declare that there is no conflict of interest in this study.

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