ORIGINAL RESEARCH

Assessment of Oral–Systemic Disease Association amongst Dental Patients: A Retrospective Panoramic Radiographic Study

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Abstract

Aim: The association between oral health and overall health has been broadly documented in the past few years and is supported by a rapidly growing body of evidence. Interventional studies were able to establish a linkage between dental intervention and its influence on medical situations. This study tried to determine whether the overall health of a subject may be correlated to radiographically noticeable dental pathology. There was a need to test a null theory of whether subjects having good oral health state had fewer systemic illnesses.

Materials and methods: This was a retrospective panoramic radiographic study of 400 radiographs of 200 women and 200 men. Subjects were divided into a control group of subjects with no medical history, and a second group with patients who had presented with a medical history. A panoramic radiograph was observed for periapical radiolucency, caries, remaining teeth, remaining root, horizontal, and vertical bone loss. The oral index (OI) was calculated and correlated with the medical status of the patient.

Results: Men demonstrated a higher incidence of horizontal bone loss and missing teeth. On the contrary, women showed higher incidences of vertical bone loss, compromised periapical index, and a greater number of root canal treated teeth. Patients having a medical history had a significant percentage of the increased number of periapical lesions, tooth loss, poor quality root canal treatment, and periapical index. Patients with both diabetes mellitus (DM) and hypertension [HTN (61.3%)], anemia (75%), prostate disease (100%), and disabilities such as hearing impairment and mental retardation (100%) had significantly higher percentages of the bad OI.

Conclusion: Most patients with medical history demonstrated a significantly poor OI than those with no medical history. The present research contributes to scientific works by probing the relationship between oral health and the overall well-being. Increasing the sample size and interventional studies are needed as an extension of the current research.

Clinical significance: Panoramic radiograph is commonly practiced as a screening radiograph in a dental setup. By calculating an OI of each patient based on certain dental conditions, it can help in revealing the burden of medical diseases on oral health and vice versa.

Keywords: Apical periodontitis, General health, Oral health, Systemic disease.

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Introduction

Seymour's statements of "You cannot have good general health without good oral health" and "The mouth is part of the body" are now significantly taken into consideration.[1] Oral cavity may be considered as a link between dentistry and medicine, both of which are considerably partially autonomous professions sharing a universal goal of enlightening patient health and quality of life.[2] Previously, Hippocrates purportedly cured systemic conditions by removing the infected tooth. However, the association and influence of oral environment on systemic settings have not been entirely appreciated until lately.[3]

The confusion regarding whether the relation between oral health and systemic well-being resulted from a causative relationship or a coincidence has been the cause of concern over the years. Furthermore, this confusion may have impeded the process of understanding these mechanisms and prevented any collaborative efforts between dentistry and general medicine. Although the association between oral and systemic conditions, which is two-directional, is gradually becoming better understood, there is a need for a significant amount of research.[4] The benefits of good oral health are well studied and it is considered to be the sum of economic, social, psychological, and physical fitness.[5] Garcia et al. stated that life quality depends on the number of teeth, and the more number of missing teeth could be associated with a relatively inferior quality of life.[6]

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Poor dentition can lead to difficulty in chewing and may have harmful consequences of nutritional intake. Fact that the relationship between these two parameters was significantly clear, many effects and correlations between oral and serious systemic conditions highlight the importance of a collaborative approach. Chronic oral health conditions generate an enormous burden

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on an individual's health along with the whole of the healthcare setting. Routine and regular dental care is essential because it not only prevents periodontal diseases but helps to classify patients who are at significant risked of more serious systemic conditions. Studies have projected that 75% of the individuals born between the year 1946 and 1964 will be in long-term care amenities with most of their intact natural teeth. Therefore, it is understood that subjects with good oral hygiene habits do not need to invest much capital in healthcare expenses.[7]

Among the systemic conditions that have an either coincident or causal relation to oral diseases are cardiovascular disease (CVD) and pulmonary disease, diabetes, pregnancy, birth weight, osteoporosis, and renal disease. Our study attempted to appraise the overall oral health status of an individual using a panoramic radiograph to correlate it with the subject's diagnosed medical diseases; therefore, it would test the hypothesis of the interrelation of systemic and oral well-being. This would be the first reported study in the Saudi population. Thus, the study aimed to prepare an OI for the patient based on the radiographically evident dental pathologies and to correlate with their medical conditions.

Materials and Methods

This was a retrospective panoramic radiographic study that included 400 radiographs of 200 women and 200 men. The men and women were divided into two groups and were age matched. The control group included patients without any medical history and the latter included patients with a medical history. The general health and medical history of the patient was assessed from the case record, which was mentioned during the diagnostic procedure while attending King Khalid University, College of Dentistry for treatment. The oral health of these patients was judged from a panoramic radiograph by two independent observers. Panoramic radiographs were retrieved from the radiology department, which was considered as a screening radiograph during the patient's diagnostic procedure in the University. A panoramic radiograph was observed for periapical radiolucency, caries, remaining teeth, the root remains, horizontal, and vertical bone losses. The OI was calculated from different parameters and correlated with the medical status of the patient. Oral index was calculated from the various significant oral pathologies that can be detectable in the radiograph. The technique implemented in this research for measuring the oral state of health was a modified version of oral health measure practiced by Relvas et al.[8] and Joseph et al.[9]

It included several caries, bone loss, periapical pathology, and tooth loss. Five parameters were calculated, and the least score was 0 and the highest score was 9 (Table 1). After getting a total score, a two-point scale was designed. Scores of 0 to 4 were categorized as good OI while 5–9 scores were categorized under the bad OI. The cutoff values for good and bad oral health were calculated as followed. An equation was derived in which the class width (CW) was obtained. The CW = (maximum value − minimum value)/(number of required class intervals). After adding the score of the individual category, a total score was obtained. Later, it was converted into a two-point ordinal scale.

Individual scoring for each pathology was as follows: caries were assessed and graded. Patients with no caries were given a score of zero. Those with one to three carious lesion were given a score of 1 and four to seven lesions, a score of 2. More than eight carious lesions were scored with a higher score of 3. Bone loss was measured and those who are not having any bone loss were given a score of 0. A score of 1 each was given for the presence of horizontal and vertical bone loss. Tooth loss was calculated and those radiographs with 28 or more teeth were given a score of zero. Those with less than 10 teeth missing were given a score of 1 and those with more than 10 teeth missing were given a score of 2. The presence of periapical lesions was recorded and a score of 0 was given for those who did not have any periapical lesions. A score of 1 was used to record when one to two teeth were affected. Subsequently, a score of 2 was given when three or more teeth were affected. The OI of a patient was calculated by adding all these scores. The maximum score that can be obtained was 9 and the minimum score was 0. In addition to it, the number and quality of root canal-treated teeth were assessed. The periapical index was calculated and was given a score.[10] The periapical index (PAI) score was 1 when there was a normal periapical structure in the radiograph. Small changes to the bone structure were given a score of 2 and a score of 3 was given when there were bone structural changes with mineral loss. A score of 4 was given for a case of well-defined radiolucent areas in the radiograph. A score of 5 was given when there were features of exacerbation.[10]

Table 1: Parameters included in oral index calculation and individual scoring

Pathologies	*Score*
Caries	
No caries	0
1–3 carious lesions	1
4–7 carious lesions	2
≥8 carious lesions	3
Horizontal bone loss	
Absent	0
Present	1
Vertical bone loss	
Absent	0
Present	1
Tooth loss	
All teeth present ≥28	0
<10 teeth missing	1
>10 teeth missing	2
Periapical lesions	
None	0
1–2 teeth	1
≥3 teeth	2

Statistical Analysis

Data analysis was performed using version 21.0 of the Statistical Package for the Social Sciences (SPSS; IBM, Armonk, NY, USA). For all evaluations of the current study, we considered a *p* value of less than 0.05 to be statistically significant. Chi-square tests and independent *t* test were applied for analysis.

Results

The sample size was 400, of which 200 were men and 200 were women. The mean age of male patients was 43.67 ± 14.954 and of females was 39.48 ± 13.032. There was no statistically significant relation in terms of age. Mean ± standard deviation (SD) for the age of subjects with no medical history was 40.90 ± 15.61; with

minimum age was 18, and the maximum age of 70 with a range of 52 years. Mean ± SD for the age of subjects with medical history was 40.12 ± 12.43; with minimum age being 18 and the maximum age 70, with a range of 52 years (*p* value = 0.592). Table 2 shows different medical conditions recorded in various patients and their age-group. In all 231 subjects with a positive medical history and 169 subjects with no medical history were included. Table 3 describes a frequency distribution showing the comparative evaluation of oral health-related variables between the study groups. Chi-square test was applied at 95% confidence interval (CI) for variables such as caries, several periapical lesions, horizontal bone loss, vertical bone loss, quality of root canal, tooth loss, periapical index, and OI. Independent *t* test (test of significance) was applied at 95% CI for variables like the number of root canals and remaining roots. The number of carious lesions between male and female patients did not show any significant difference (*p* value 0.675). There were no carious lesions among 21% of males and 17.5% of females. In 42% of men and 46.5% of women, one to three carious lesions were observed. In 31% of men and 31.5% of women, four to seven carious lesions were seen. Eight and more carious lesions were seen in 6% of men and 4.5% of women. A significant difference was noted in the case of the number of periapical lesions among males and females; 40% of men and 28% of women had no periapical lesions.

Most of the men (40%) had a significant absence of periapical lesion when compared with women (28%) with a *p* value of 0.009. Men (88%) have reported a significant amount of horizontal bone loss (*p* value 0.001) when compared with women (75%). The majority of the women (37%) have demonstrated the significant presence of vertical bone loss when compared with the men (20.5%) with a *p* value of 0.000. Women had a greater number of mean root canal procedures in comparison with men (*p* value 0.000). Most of the women (36.5%) reported significantly good quality of root canal, in comparison with men (19.5%) with a *p* value of 0.000. In the case of tooth loss, most of the men (18%) demonstrated significantly more than 10 teeth missing compared to women (10.5%) with a *p* value of 0.002. When the periapical index was calculated, most of the women had significantly compromised the periapical index compared to men (*p* value 0.031).

Table 4 shows the comparison of oral health-related variables between study groups. Chi-square test was applied at 95% CI for variables such as caries, several periapical lesions, horizontal bone loss, vertical bone loss, quality of root canal, tooth loss, periapical index, and OI. An independent *t* test was applied at 95% CI for variables such as the number of root canals and remaining roots.

In patients with no medical history, i.e., 23.4% and 13.6% of subjects with medical history had no carious lesion; 40.3% of subjects with no medical history had one to three carious lesions, whereas 49.7% of subjects with positive medical history had one to three carious lesions. In 31.2% of subjects with no recorded medical history and 31.4% with a medical history, four to seven carious teeth were seen. Eight and more lesions were seen in 5.2% of subjects with no medical problems and 5.3% of subjects with medical problems. These correlations were not statistically significant (*p* value 0.078). Regarding the number of periapical lesions, 39.8% of subjects with no medical history had no periapical lesions and 26% of subjects with medical problems had no periapical lesions. Of the subjects with no medical problems 34.6% had one to two lesions, whereas 45% with medical history had one to two lesions. Of the subjects with medical history, 29% had three and more lesions. However, 25.5% with no medical problems had three and more lesions. The correlation was statistically significant with a *p* value of 0.014. Horizontal bone loss was absent in 16.5% subjects with no medical history and 21.3% with a medical history. Horizontal bone loss was observed in 3.5% of patients with no medical history and 78.7% with a medical history (*p* value 0.217). About vertical bone loss, 80.1% with no reported medical history and 59.2% with the

Table 2: Frequency distribution table showing comparative evaluation of biographic variable between the study groups (medical history) and percentages of each medical conditions

		Descriptive statistics		*Inferential statistics*
S. no	*Variable*	*No medical history (n = 231)*	*Positive medical history (n = 169)*	*p value*
1	Age expressed as mean ± SD; minimum, maximum, range	40.90 ± 15.61; 18, 70, 18–70	40.12 ± 12.43; 18, 70, 18–70	0.592
2	Medical history	Absent	57.8%	
		Diabetes mellitus	15.5%	
		Hypertension	4.5%	
		DM + HTN	7.8%	
		Asthma	4.8%	
		Epilepsy	0.5%	
		Osteoporosis + arthritis	1%	
		Anemia	2%	
		Thyroid diseases	2%	
		Rheumatoid arthritis	0.5%	
		Peptic + colonic ulcers	0.8%	
		Prostate disease	0.3%	
		Cancer	1%	
		Hearing impairment + mental retardation	1%	
		Hepatitis	0.5%	
		Psychological diseases	0.3%	

Table 3: Frequency distribution table showing comparative evaluation of oral health-related variable between male and female

			Descriptive statistics		*Inferential statistics*
			Study group		
S. no	*Variable*	*Responses*	*Male*	*Female*	*p value*
1	Caries: expressed as *n* (%)	No caries = 0	42 (21.0)	35 (17.5)	0.675
		1–3 carious lesions	84 (42)	93 (46.5)	
		4–7 carious lesions	62 (31)	63 (31.5)	
		≥8 carious lesions	12 (6)	9 (4.5)	
2	Number of periapical lesions (apical periodontitis): expressed as *n* (%)	None	80 (40)	56 (28)	0.009
		1–2 lesions	64 (32)	92 (46)	
		≥3 lesions	56 (28)	52 (26)	
3	Horizontal bone loss: expressed as *n* (%)	Absent	24 (12)	50 (25)	0.001
		Present	176 (88)	150 (75)	
4	Vertical bone loss: expressed as *n* (%)	Absent	159 (79.5)	126 (63)	0.000
		Present	41 (20.5)	74 (37)	
5	Number of root canal: expressed as mean ± SD; minimum, maximum	1.62 ± 2.407; 0, 11	3.53 ± 3.349; 0, 17	0.000	
6	Quality of root canal: expressed as *n* (%)	None	101 (50.5)	43 (21.5)	0.000
		Good	39 (19.5)	73 (36.5)	
		Fair	37 (18.5)	40 (20)	
		Poor	23 (11.5)	44 (22)	
7	Remaining roots: expressed as mean ± SD; minimum, maximum	0.97 ± 2.025; 0, 12	1.08 ± 1.607; 0, 7	0.566	
8	Tooth loss: expressed as *n* (%)	All teeth present ≥28	101 (50.5)	83 (41.5)	0.002
		<10 teeth missing	63 (31.5)	96 (48)	
		>10 teeth missing	36 (18)	21 (10.5)	
9	Periapical index: expressed as *n* (%)	Normal	85 (42.5)	58 (29)	0.031
		Bone structural changes	56 (28)	65 (32.5)	
		Bone structural changes with signs of mineral loss	24 (12)	40 (20)	
		Radiolucency	22 (11)	27 (13.5)	
		Radiolucency with features of exacerbation	13 (6.5)	10 (5)	
10	Oral index: • Five items are measured • Minimum score is 0 and maximum score is 9 • Total score is obtained and overall scale of 2 point is structured. • 0–4 = good oral index • 5–9 = bad oral index	Good oral index	128 (64)	120 (60)	0.410
		Bad oral index	72 (36)	80 (40)	

medical problem had no vertical bone loss (*p* value 0.000). Vertical bone loss was observed in 19.9% of subjects with no past medical history, whereas 40.8% with medical history had vertical bone loss. The connection was statistically noteworthy with a *p* value of 0.000. The number of root canal treatment was assessed from the radiograph. Subjects with no medical history had 1.75 ± 2.617 root canal-treated teeth and subjects with medical history had an average of 3.70 ± 3.278 root canal treatments with significant correlation observed with medical diseases (*p* value 0.000). The quality of root canal treatment was also assessed in each patient's radiograph. Of the patients with a medical history, 20.1% had no root canal treatments and 47.6% with no medical diseases had no root canal treatments. Good quality root canal treatment was observed in 34.3% of patients with a medical history and 23.4% of subjects with no medical history. Fair quality treatment was observed in 22.5% of subjects with a medical history and 16.9% of subjects with no medical history. Quality was poor in 23.1% of the participants with a medical history and 12.1% of those without medical history (*p* value 0.000). The remaining root was calculated and was 0.92 ± 1.928 in subjects with no medical history and 1.16 ± 1.674 with medical history (*p* value 0.199). When tooth missing was calculated, 34.9% with a medical history and 54.1% with no medical history had all teeth present (≥28). In subjects with medical history (53.3%) and those without a medical history (29.9%) had less than 10 teeth

Table 4: Frequency distribution table showing comparative evaluation of oral health-related variable between the study groups with medical history and without medical history

			Descriptive statistics		*Inferential statistics*
			Study group		
S. no	*Variable*	*Responses*	*No medical history (n = 231)*	*Positive medical history (n = 169)*	*p value*
1	Caries: expressed as *n* (%)	No caries = 0	54 (23.4)	23 (13.6)	0.078
		1–3 carious lesions	93 (40.3)	84 (49.7)	
		4–7 carious lesions	72 (31.2)	53 (31.4)	
		≥8 carious lesions	12 (5.2)	9 (5.3)	
2	Number of periapical lesions (apical periodontitis): expressed as *n* (%)	None = 0	92 (39.8)	44 (26)	0.014
		1–2 lesion = 1	80 (34.6)	76 (45)	
		≥3 lesion = 2	59 (25.5)	49 (29)	
3	Horizontal bone loss: expressed as *n* (%)	Absent	38 (16.5)	36 (21.3)	0.217
		Present	193 (83.5)	133 (78.7)	
4	Vertical bone loss: expressed as *n* (%)	Absent	185 (80.1)	100 (59.2)	0.000
		Present	46 (19.9)	69 (40.8)	
5	Number of root canal: expressed as mean ± SD; minimum, maximum	1.75 ± 2.617; 0, 17	3.70 ± 3.278; 0, 15	0.000	
6	Quality of root canal: expressed as *n* (%)	None	110 (47.6)	34 (20.1)	0.000
		Good	54 (23.4)	58 (34.3)	
		Fair	39 (16.9)	38 (22.5)	
		Poor	28 (12.1)	39 (23.1)	
7	Remaining roots: expressed as mean ± SD; minimum, maximum	0.92 ± 1.928; 0, 12	1.16 ± 1.674; 0, 7	0.199	
8	Tooth loss: expressed as *n* (%)	All teeth present ≥28	125 (54.1)	59 (34.9)	0.000
		<10 teeth missing	69 (29.9)	90 (53.3)	
		>10 teeth missing	37 (16)	20 (11.8)	
9	Periapical index: expressed as *n* (%)	Normal	97 (42)	46 (27.2)	0.027
		Bone structural changes	60 (26)	61 (36.1)	
		Bone structural changes with signs of mineral loss	32 (13.9)	32 (18.9)	
		Radiolucency	28 (12.1)	21 (12.4)	
		Radiolucency with features of exacerbation	14 (6.1)	9 (5.3)	
10	Oral index • Five items are measured • Minimum score is 0 and maximum score is 9 • Total score is obtained and overall scale of 2 point is structured • 0–4 = good oral index • 5–9 = bad oral index	Good oral index	156 (67.5)	92 (54.4)	0.008
		Bad oral index	75 (32.5)	77 (45.6)	

missing. However, in 11.8% of subjects with a medical history and 16% of subjects with no medical history, it was observed that more than 10 teeth were missing (*p* value 0.000). The periapical index was another parameter that was calculated, and it was found that 27.2% of subjects with medical history had normal periapical index than 42% of subjects with no medical history. Bone structural changes

were observed in 36.1% of subjects with a medical history and 26% of subjects with no medical history. Higher periapical index of bone structural changes with signs of mineral loss was noted in 18.9% of subjects having a medical history compared to 13.9% of subjects with an absent medical history. Total of 12.4% of subjects having a medical history and 12.1% of subjects with no medical problem had periapical index score of 3. Radiological features of exacerbation were observed in 5.3% of subjects with a medical history and 6.1% of subjects with no medical diseases (*p* value 0.027).

The good OI was observed in 54.4% of subjects with a medical history and 67.5% of subjects with no medical history. The bad OI was observed in 45.6% of subjects with a medical history and 32.5% of subjects with no medical history. Table 5 and Figure 1 show the comparison of medical conditions with OI. The Chi-square test was applied at 95% CI. Patients with both DM and HTN (61.3%), anemia (75%), prostate (100%) and disabilities like hearing and mental retardation (100%) have a significantly higher percentage of poor OI (*p* value 0.008). The type of medical conditions was compared based on each of the specific pathological condition and chi-square test was applied at 95% CI. It was found that subjects with DM + HTN (9.7%), thyroid (25%), and cancer (25%) disease had a significantly higher percentage of radiolucency with features of exacerbation (*p* value 0.025). Hypertension (22.2%), thyroid (25%), prostate (100%), and cancer (50%) have a significantly higher percentage of more than 10 teeth missing (*p* value 0.002). Subjects with HTN (30.6%), DM + HTN (32.3%), rheumatoid arthritis (50%), and prostate abnormalities (100%) had a significantly higher percentage of poor quality root canal treatment (RCT) (*p* value 0.000). Hypertension (30.6%), DM + HTN (45.2%), epilepsy (50%), osteoarthritis (50%), psychological diseases (100%), and prostate conditions (100%) had a significantly higher percentage of vertical bone loss present (*p* value 0.000). More than or equal to three periapical lesions were observed in subjects with HTN (38.9%), DM + HTN (45.2%), epilepsy (50%), hepatitis (100%), psychological (100%), and prostate disease (100%) with a *p* value of 0.095.

Table 5: Comparative evaluation of medical conditions with oral index

Medical condition	*Good oral index*	*Bad oral index*	*p value*
Nil	156 (67.5)	75 (32.5)	0.002
DM	36 (58.1)	26 (41.9)	
HTN	10 (55.6)	8 (44.4)	
DM + HTN	12 (38.7)	19 (61.3)	
Asthma	14 (73.7)	5 (26.3)	
Epilepsy	2	0	
Osteoporosis + arthritis	3 (75)	1 (25)	
Anemia	2 (25)	6 (75)	
Thyroid disease	6 (75)	2 (25)	
Rheumatoid arthritis	2	0	
Peptic + colon ulcer	3	0	
Prostate disease	0	1	
Cancer	2	2	
Hearing impairment + mental retardation	0	4	
Hepatitis	0	2	
Psychological diseases	0	1	

Discussion

It has become progressively clear that the oral cavity can be a focus of the source for spreading of pathogenic organisms to distant areas, especially in immunocompromised hosts such as patients with diabetes, malignancies, rheumatoid arthritis, or those on steroidal or other immunosuppressive treatment. It is also been proposed that infection in the oral cavity such as apical periodontitis (AP) may act as a risk factor for systemic diseases.[11]

It was found that chronic infections of oral cavity such as endodontic or periodontal origin can liberate inflammatory mediators, which can extend to systemic level. Systemic diseases and oral infections have seem to be closely related as they share many associated risk factors.[12] This study attempted to investigate the possible relation with systemic disease and radiographically detectable pathologies in a specific population who were visiting the dental university.

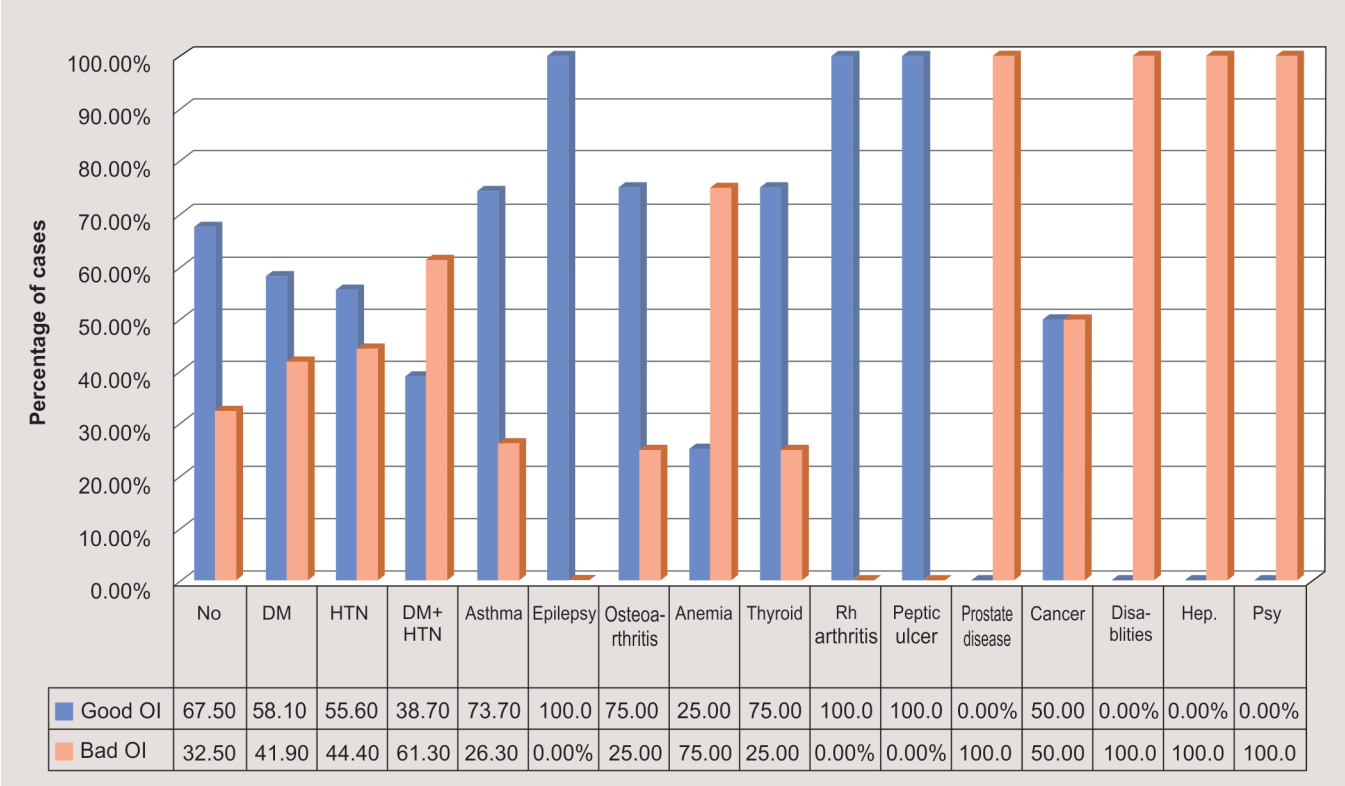
A panoramic radiograph was selected as it is used in patients as a screening radiograph with less radiation burden and are widely available. With a relatively simple diagnostic and radiographic method, we could categorize patients and focus on their overall health by a standardized method of classification called OI.

In the initial assessment, various radiographic pathologies were correlated with their diagnosed medical conditions. A statistically significant correlation was observed in various oral conditions such as vertical bone loss, number of periapical lesions, tooth loss, and periapical index with their medical conditions. Overall oral health status from radiograph was calculated based on the presence/severity and absence of each oral condition. This generalized OI was used easily to standardize and demonstrate the oral health status of each patient. Good and the bad OIs were scaled and compared with medical conditions. Patients having bad oral indices were associated with many systemic conditions. In the present study, we used oral state or health scale which was a modified version of oral health measure practiced by Relvas et al.[8] and Joseph et al.[9]

In the dental literature, many described combinations of different variables to make the health scales. The idea of demonstrating the oral health state in a single numerical value obtained particular attention with the growth of the concept of "periodontal medicine", which entails launching correlations between infectious or inflammatory disorders of the oral cavity and the onset of certain systemic diseases.[13] In this article, we propose an oral health scale based on radiographically evident pathologies that enable us to get an average potential infections of the oral cavity to be condensed into a single parameter.

It was found from a systematic review by Aminoshariae that some systemic diseases such as diabetes/cardiovascular system (CVS) disease may be linked to the endodontic outcome even though scientific evidence remains questionable.[12] Ueta et al. have found a high prevalence of pulp-periapical and periodontal infections in diabetic patients.[13] Britto et al. in his study found that 97% of diabetic and 87% of control patients had one or more teeth with AP and concluded that no significant connotation between AP and patients with diabetes. However, Segura-Egea et al.'s study determined AP in periapical radiographs and periapical index in patients with and without type 2 DM patients. Results established a significant relationship between AP and diabetes patients, 81 vs 58% between diabetes and controls (OR = 3.2; $p < 0.05$).[14]

Studies have connected systemic disease and oral infection in such a way that it demonstrates a solid bidirectional association between infection of endodontic origin and diabetes by displaying



	No	DM	HTN	DM+ HTN	Asthma	Epilepsy	Osteoa-rthritis	Anemia	Thyroid	Rh arthritis	Peptic ulcer	Prostate disease	Cancer	Disa-blities	Hep.	Psy
Good OI	67.50	58.10	55.60	38.70	73.70	100.0	75.00	25.00	75.00	100.0	100.0	0.00%	50.00	0.00%	0.00%	0.00%
Bad OI	32.50	41.90	44.40	61.30	26.30	0.00%	25.00	75.00	25.00	0.00%	0.00%	100.0	50.00	100.0	100.0	100.0

Fig. 1: Comparison of medical condition to oral index

an effect on sudden improvement in insulin sensitivity after endodontic treatment.[15] Study by Sánchez-Domínguez showed a prominent relation with poorer periapical status and higher HbA1c values in diabetic patients.[16]

Diabetes and CVDs were the most explored systemic illnesses associated with endodontic infections, only an insignificant number of studies have explored the possibility of two-directional relation between AP and other systemic ailments. Khalighinejad et al. reported that endodontic pathosis was correlated to DM, HTN, CVD, osteoporosis, chronic liver disease, and hemophilia.[17] Khalighinejad et al. in their cross-sectional study assessed the occurrence of AP in end-stage renal disease (ESRD) patients. It was observed that 73% of patients with ESRD and 40% of control had AP. Moreover, a minimum of one endodontically treated tooth was observed in 52% of the ESRD patients, while the control group had 28%. Although it could be concluded that ESRD has a role in the pathogenesis of AP, the cause and effect association was not proved.[18] The relation between maternal AP and preeclampsia was observed in a case–control study. It showed that 54% of the mothers who had preeclampsia had AP in at least one tooth in comparison with AP in 16% of the mothers who had a normal pregnancy. Study results determined that maternal AP may be considered as an independent risk predictor of PE.[19] Piras et al. estimated the occurrence of AP in patients with inflammatory bowel disease (IBD) who were under treatment with immunomodulators. Patients underwent a thorough oral and radiographic checkup. It was found that female patients with the disease had a higher prevalence of AP. Compared to healthy subjects, patients who had IBD presented with larger periapical lesions. Gronkjær et al. observed the prevalence of AP in cirrhosis patients. Apical periodontitis and its relation to systemic inflammation and cirrhosis-associated consequences were observed in the study. These results showed that patients with AP had a low value of albumin and high value of C-reactive protein than those without AP. Moreover, patients with AP showed a significant relation with cirrhosis-related complications.[20] It was shown by Gomes-Filho et al. that low estrogen level may stimulate osteoclast activity, thus increases receptor activator for nuclear factor k B ligand (RANKL) and inflammatory cell in the course of AP.[21]

Regarding several teeth and its relation, it was observed that there was a link between oral health and CVD and that the number of teeth is a proper gauge for oral health.[22] General and abdominal obesities were found to have a substantial association with tooth loss which was age independent.[23] The risk of developing various cancers was linked to tooth loss and periodontal disease.[24]

This study attempted to identify the overall oral health by considering all the important dental diseases that may contribute to the inflammatory and infectious component and thus help to reach a standardized classification system. By calculating an OI of the patient, it infers the total oral health burden of the patient at the point of examination. The OI calculated could be used as a tool for educating the patient toward the improvement of overall health.

Previous studies have reported the interrelation of either unidirectional or bidirectional with certain systemic diseases to largely with AP. This study has considered the entire oral health burden of a patient by calculating the OI and attempted to relate the diagnosed medical condition of the patient. Although the relation between systemic diseases and oral health is a contentious subject, many previous studies showed a strong relation displaying poor oral health due to compromised systemic health or worsening the systemic disease due to bad oral situations. The groundwork was done in a specific population, and the study result can be taken as a foundation and information can be used as a prominent fact

for keeping the goal of eliminating the oral focus of infection as one of the ways to improve the systemic state. The relation of the medical and dental field can work hand in hand for the overall health of an individual with further studies to be performed to better understand these interactions.

Conclusion

Both medical and dental professions focus on patients' health. Some specific chronic illnesses such as CVD, pulmonary disease, and diabetes are the major conditions that have been well considered and studied for their association with oral health, but the possibility of other systemic conditions having a similar consequence should not be excluded. Statistical analysis is used as a part of the research, and the methodology should be applied by physicians and dentists by refining the relation and teamwork and thus can have an impact on the patient's health. Application of the OI which will provide a standardized tool to evaluate oral health. With the aid of a panoramic radiograph, which is currently used as a screening radiograph, and thus avoiding an additional burden of radiation dose to the patient and proper recording of medical history and review of systems will help us focus on improved enhancement of the overall health of a subject.

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