ORIGINAL ARTICLE

Relationship between Osteoporosis and Dental Concerns: Exploring the Impact on Oral Health

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ABSTRACT

Osteoporosis leads to bone loss due to deficiency of minerals needed for building bone mass, which significantly inspirations a dental problems through affecting the jawbone. This study focused on mineral examination and decayed, missing, filling index (DMFT) as biomarker for diagnosing of osteoporosis. The panoramic radiography approves the relation between mandibular bone density and the disease. This case-control study was conducted on a total of 64 patients with osteoporosis aged between 35 and 65 years (36 females and 29 males), who were selected from patients referred to the Radiology Clinic at College of Dentistry, Al-Iraqia University, Iraq. A comparison was done with 20 healthy participants serving as a control group. The working out concluded that serum calcium, phosphate, alkaline phosphate (ALP) and vitamin D are predictors of bone mineral density (BMD), which is directly related to the decayed, missing and filling index (DMFT) and thus contributes to the early diagnosis of osteoporosis using panoramic radiography to provide conclusive evidence of the above-mentioned disease. There was a significant difference (p=0.001) in biochemical factors in osteoporotic individuals. The panoramic radiographic images changes indicative of the evaluated condition using the Mandibular Cortical Index (MCI) to detect changes suggestive of osteoporosis. Moreover, highly significant difference between frequency of decay and missing teeth in comparison to the filled teeth in the study group (p=0001).The patients suffering from missing teeth and low bone mineral density need rapid identification of the risks for osteoporosis dental patients.

Keywords: Osteoporosis, oral health, bone mineral density.

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INTRODUCTION

Osteoporosis is a disease in which the skeletons become more delicate as drop density, frequently owing to elderly, menopause, and supplementary factors like absence of calcium and vitamin D in the diet[1]. Knowledge has to be monitor of the basic elements were retaining bone fitness and preventing bone disease specifically those who have developing osteoporosis. One of the most important desires in the current study is to keep oral bone health by way of preventing bone loss[2]. The range of remaining tooth could be associated with oral density may also be related with the aid of dentists/dental hygienists may additionally play an essential function in preserving bone mineral density in elderly[3]. Densitometry measures bone mineral density for the prevention of osteoporosis;

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it is very important to detect bone loss as early as possible[4]. Many studies have shown that tooth loss is associated with a decrease in bone mineral density[5]. Post-menopausal women with normal bone mineral density lose an average of 6.8 teeth, those with osteopenia an average of 10.5 teeth, and those with osteoporosis an average of 16.5 teeth, and those with osteoporosis lose an average of detention and stability of teeth. Additionally, Bone mineral density is measured by densitometry to prevent osteoporosis[6]. The reduction of bone mineral density tooth decay and gum disease are significant concerns for identification the risk of osteoporosis in dental patients[7]. The section of the jaw that houses the teeth, known as the alveolar processes, consists of bony tissue in both the upper and lower jaw. Patients with osteopenia and osteoporosis face an increased risk of tooth loss and a reduction in alveolar crest height[8].

METHODS

Study design: In this case-control study, a total of 64 adult osteoporosis patients aged between 35 and 65 years (35 female and 29 male) were selected from patients referred to a radiology clinic of the College of Dentistry, Al-Iraqia University, Iraq, preceding to the study and they for one or more years suffering from disease. A comparison was done with 20 healthy participants serving as a control group.

Specimen preparation: Patients had undergone a densitometry test and diagnosis the case before the research performs prior to the evaluation. The study performed to assess the concentration of serum calcium, phosphate, alkaline phosphatase (ALP), and vitamin D as indicators of bone mineral density (BMD). Using manual techniques with a spectrophotometer device, Exclusion criteria applied to individuals with hyperparathyroidism, a history of diseases, or conditions involving medications that could influence bone and mineral metabolism.

Biochemical assay: We collected 3ml of blood sample from each participants for analysis. Subsequently, a qualified evaluator conducted comprehensive examination of the oral cavity to see the oral health status. The DMFT index, which ranges from (0 to 32) was utilized to quantify the number of decayed, missing, and filled permanent teeth in an individual's mouth[9]. Osteoporosis was classified based on bone mass, categorized as normal up to (-1) SD, osteopenia from (-1.0 to -2.5) SD, and below (-2.5) as osteoporosis[10]. The procedure started with the measurement of vitamin D samples using Electro Chemiluminescence (ECL) technology for immunoassay analysis conducted by the Cobas E41 device. Vitamin D levels below 12 ng/ml considered as severely deficient, while levels below 20 ng/ml are deemed deficient, levels between (20-29) ng/ml are classified as insufficient, and the levels between (30-50) ng/ml are regarded as normal. Serum calcium, phosphate, and alkaline phosphatase (ALP) were measured using manual techniques with a spectrophotometer device.

Panoramic radiography assessment: The densitometry examination and analysis the circumstance beforehand the investigation achieves earlier toward the assessment fixed by panoramic radiography unit (OPG) of the Carestream/CS900 (USA) type, serial number CCXY047, with a Toshiba x-ray tube (serial number 28508, Japan) running at 100 kV and 10 mA, was used for the diagnosis.

Data Analysis: Statistics were calculated Mean±SD (standard deviation) for every variable inspection. Sample t-test used to associate sample values. A p-value ≤ 0.05 was considered significant. We used SPSS 23.0 to design and investigate our collected data.

RESULTS

A total of sixty- four persons contributed in this study, 25-Vitamin D with calcium, phosphate and alkaline phosphatase were measured as demonstrated in Table 1. Our results revealed that calcium, phosphate and 25-OHVitD decrease while alkaline phosphatase increase due to metabolic changes. Table 2 demonstrates the comparison of serum 25-OH vitamin D3 between the study and the control groups; the difference highly significant between the testing groups and control (p=0001). The 95% confidence interval of the difference of 25-OH vitamin D3 was between the lower limit (10.83ng/ml) and the upper (13.5 ng/ml), while the lower limit of the control (17.82 ng/ml) and the upper (40.2 ng/ml). Table 3 illustrates the comparison of serum calcium, phosphate and alkaline phosphatase (ALP) between the study groups with control groups. The 95% confidence interval of the difference of serum calcium were between the lower limit (8.4

mg/dl) and the upper (8.9mg/dl), while the lower limit of the control (9.3 mg/dl) and the upper (9.6 mg/dl) (p=0001). The 95% confidence interval of the difference of serum phosphate was between the lower limit (2.3 mg/dl) and the upper (2.7 mg/dl), while the lower limit of the control (3.7mg/dl) and the upper (4.0 mg/dl) respectively (p=0001). The 95% confidence interval of the difference of alkaline phosphatase were between the lower limit (202.6U/L) and the upper (215.8U/L), while the lower limit of the control (93.7U/L) and the upper (110.9 U/L) (p=0001). For Sixty-four participants, panoramic radiographs were selected representing patients with history of osteoporosis and exhibited panoramic radiographic changes indicative of the condition. These images were evaluated using the Mandibular Cortical Index (MCI) to detect changes suggestive of osteoporosis as shown in Figure 1 and Table 4. Figure 2 illustrates the relationship between frequency of decay, filled and missing teeth (DMFT) index in patients and healthy subjects. Table 5 shows that highly significant difference between frequency of decay and missing teeth in comparison to the filled teeth in the study group (p=0001).

Table 1. Demographic distribution of biochemical factors in osteoporotic individuals (N=64)

Parameters	25-OH vitamin D (ng/ml)	Phosphorus (mg/dl)	Calcium (mg/dl)	Alkaline phosphatase U/L
Mean±SD	12.1±3.9	2.5±0.62	8.7±0.7	209±28. 7
Median	10.00	2.50	8.50	209
Minimum	9.00	1.40	7.50	202
Maximum	20.00	4.00	10.00	215

Table 2: Comparison of 25-OH vitamin D3 between study group and control group

Groups	t	df	Sig. (2-tailed)	Mean difference	95% confidence interval of the difference	
					Lower	Upper
S. 25-OH vitamin D (ng/ml) Study group	18.8	38	.000	12.1	10.82	13.5
Control group	5.3	26	.000	29.0	17.82	40.2

Sample t-test was applied.

Table 3: Comparison of serum calcium, phosphate and ALP between study group and control group

Parameters	t	df	Sig. (2-tailed)	Mean difference	95% confidence interval of the difference	
					Lower	Upper
S. calcium (mg/dl) Study group	75.6	38	.000	8.6	8.4	8.9
Control group	103	26	.000	9.5	9.3	9.6
S. phosphate (mg/dl) Study group	25.1	38	.000	2.5	2.3	2.7
Control group	52.4	26	.000	3.9	3.7	4.0
ALP (U/L) Study group	63.0	75	.000	209.2	202.6	215.8
Control group	24.2	33	.000	102.35	93.73	110.9

Sample t-test was applied.

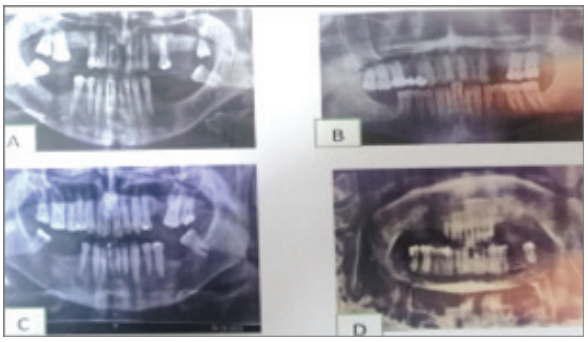

Figure 1: Panoramic radiographs detection are screening tools for osteoporosis.

Table 4: Distribution of DMFT Index in between male and female

Parameters	Total (Mean±SD)	Female (Mean±SD)	Male (Mean±SD)
Frequency	20 (30%)	26 (40.9%)	18 (29.1%)
DMFT	4.8±0.32	4.5 ±0.9	4.1±3.7
DT	1. 86±0.123	1.7 ±0.166	1.78±0.16 2
MT	0.85 ±0.77	0.8 3±0.77	0. 838±0.6 2
FT	1.4 3±0.161	1.70±0.4	1.62±0.20

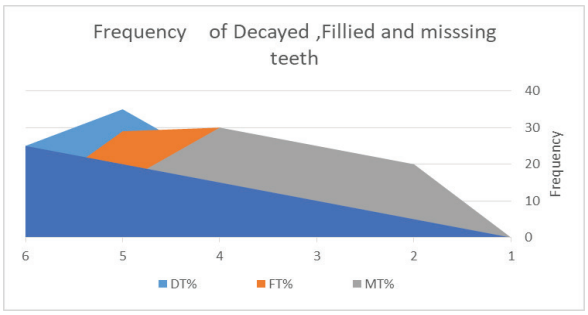

Figure 2: Frequency of Decay, Filled and missing teeth in study group

Table 5: Comparison of DMFT values

Parameters	Test Value = 1					
	t	df	Sig. (2-tailed)	Mean difference	95% confidence interval of the difference	
					Lower	Upper
DMFT	71.3	64	.000	2.88	2.8	2.96
DT	38.68	64	.000	0.7820	0.74	0.820
MT	-16.78	64	.000	-0.16	-0.181	-0.14
FT	3.23	64	.002	0.630	0.2390	1.01

Sample t-test was applied.

DISCUSSION

X-rays evaluate the mineral and calcium composition of a bone fragment. An increase in mineral content leads to greater abundance. Consequently, the bones become denser, resulting in increased strength and reduced brittleness. The likelihood of sustaining a fracture during a fall deteriorates in relation to the deficiency of minerals[11]. Extremely rare genetic disorders account for the categorization of primary osteoporosis, whereas secondary osteoporosis emerges as an issue associated with the higher prevalence of individuals suffering from chronic health conditions[11,12]. Furthermore, medications utilized in the management of osteoporosis (such as bisphosphonates) may produce negative side effects within the oral cavity. Additionally, the pediatric dentist plays a crucial role within the healthcare team[12], providing guidance to patients regarding lifestyle changes and other modifiable factors that may arise from an early age in relation to the onset of the disease. Dental osteopenia (characterized by inadequate bone, particularly in the mandible is another condition that significantly affects the elderly, often associated with tooth loss and poorly fitting dentures[13].

Osteoporosis represents a more advanced stage where bone density is significantly diminished, description bones more susceptible to fractures. To elaborate, osteopenia is an initial stage of bone loss and acts as an indicator of the possible onset of osteoporosis. Proactive measures such as engaging in physical activity and maintaining a nutritious diet can help prevent the progression to osteoporosis[14]. The treatment for osteoporosis may also prove beneficial in addressing dental osteopenia. The disease of osteoporosis is linked to various risk factors, and growing evidence indicates a potential connection with oral health issues, including periodontal disease, diminished jawbone density, and tooth loss[15]. In addition to the impact of osteoporosis on oral health, the main finding of this study reveals a significant correlation between the DMFT index and bone mass, as well as a relationship between the DMF index and inadequate levels of calcium and phosphate, coupled with insufficient vitamin D and a reduced number of remaining teeth. These finding are consistent with a previous research indicating that vitamin D deficiency requires monitoring of oral health and healthcare[16]. Furthermore, a deficiency of estrogen in elderly

postmenopausal women during voluntarily contributed in the period of this study has been identified as a causative factor[17]. Several authors reported association of tooth loss with lower bone mineral density (BMD)[18-20]. Research indicates that elderly individuals who consume calcium and vitamin D supplements experience a notable reduction in tooth loss. Additionally, improved bone mineral density may be linked to their educational background and adherence to proper oral hygiene practices[21]. It is essential to support oral health and consider the necessary principles for oral and dental safety against pathological threats [22].

CONCLUSION

There is concrete evidence supporting the benefits of mineral and especially vitamin D on bone metabolism, which leads to increased bone mineral density (BMD) and enhanced oral health, as evidenced by a decrease in falls and remaining teeth. Weakened bones resulting from aging, menopause, and deficiencies in calcium and vitamin D lead to osteoporosis, characterized by increased bone porosity. The DEXA scan serves as a diagnostic tool that evaluates bone mass in the hip, spine, and wrist to identify osteoporosis. However, this test has limitations as it solely assesses bone density without providing insights into the bone's structural integrity. Utilizing advanced imaging techniques and innovative computational methods, researchers are discovering ways to locate individuals at higher risk of fractures. The only imaging technique that enables us to achieve a precise three-dimensional representation of the bone is CT scanning of the spine and hip, thereby allowing for an evaluation of the bone's strength.

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Ethical approval: The study protocol was reviewed and approved by the Institutional Ethics Committee of College of Medicine, University of Fallujah, Anbar, Iraq.

Authors' contribution: Taghreed H. Al-Sadoon did initial draft apart from formal analysis, methodology, project administration, results validation. Amaal Al-nuaimy followed up on the patients under study, performed radiological imaging, and interpreted the results. Waleed K. Ahmed did data curation, formal analysis, methodology, project administration. Malak Shaker did application of the criteria for diagnosing conducted comprehensive examination of the oral cavity and applied exclusion criteria to the individuals and m,anuscript reviewand editing. All authors finalized the manuscript prior to submission.

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