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Original Research

Assessment of radiographic manifestations of teeth and jaw bones in chronic renal failure patients

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ABSTRACT:

Objectives: The current study's objective was to assess how teeth and jaw bones appeared on radiographs in patients with chronic renal failure (CRF). **Methods**: The mean for the antegonial index (AI), mental index (MI), panoramic mandibular index (PMI), and mandibular cortical index (MCI) was calculated using CBCT images taken from 50 patients with CRF and 50 control patients (26 males and 24 females). The paired t-test was used to compare the MI, AI, and PMI, the size of the pulp chamber, the number of teeth with pulp calcification, and the lamina dura loss, while the 2 test was used to examine the MCI values. **Results**: Patients with CRF and the control group shared the same age and gender variables. When compared to the healthy controls, there were no statistically significant variations between the MI, PMI, or AI of the CRF patients. Patients with CRF had MCIs with a more porous texture. Although there were 26.7% of CRF patients who had Class III MCI, there were none in the control group. The number of teeth with pulp calcifications and the size of the pulp chamber in patients with CRF compared to those in the control group did not differ in a statistically significant way. However, patients with CRF had a larger percentage of teeth with lamina dura loss (p 0.001). Additionally, CBCT was able to identify soft tissue calcifications, and there were noticeable differences between patients with CRF and the control group. For instance, 73% of patients with CRF had at least one soft tissue calcification, whereas only 33% of the control group did. Additionally, radiolucent abnormalities (brown tumours) were found in the jaws of three of the CRF patients (20%), but not in the control group's jaws. **Conclusions**: In patients with CRF, radiographic abnormalities in the jawbones may frequently be observed. When evaluating osseous findings, pulp chambers, soft-tissue calcifications, and MCIs, CBCT is a useful diagnostic tool since it enables determination of indices in three dimensions devoid of superposition.

Keywords: chronic renal failure, mandibular cortical index, CBCT

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INTRODUCTION

Chronic kidney disease (CKD) is defined as the presence of kidney damage or an estimated glomerular filtration rate (eGFR) less than 60 ml/min/1.73 mt2, persisting for 3 months or more, irrespective of the cause.[1] It is a state of progressive loss of kidney function ultimately resulting in the need for renal replacement therapy (dialysis or transplantation). Kidney damage refers to pathologic abnormalities either suggested by imaging studies or renal biopsy, abnormalities in urinary sediment, or increased urinary albumin excretion rates. The 2012 KDIGO CKD classification recommends details about the cause of the CKD and classifies it into 6 categories based on glomerular filtration rate (G1 to G5 with G3 split into 3a and 3b). It also includes the staging based on three levels of albuminuria (A1, A2, and A3), with each stage of CKD being sub-categorized according to the urinary albumin-creatinine ratio in (mg/gm) or (mg/mmol) in an early morning “spot” urine sample.[2]

Dental panoramic radiographs have a long history of examining current dentition, temporomandibular joint, jawbones and related structures, and have been shown in recent clinical studies to play a critical role in the identification and evaluation of patients with low bone mineral density. Mandibular bone quality can be assessed using intraoral radiographs, panoramic radiographs, CBCT, quantitative and dual-energy X-ray absorptiometry.[3,4] There are several

radiomorphometric indices that use measurements in panoramic radiographs, which have been suggested as possible indicators of decreased value of bone mineral density.[5,6] It was shown that CBCT can also be used to determine mandibular indexes in several studies.[7,8,] Panoramic radiography cannot illustrate the buccolingual width and also distorts the images. CBCT is capable of providing accurate, submillimetre-resolution images in formats allowing three-dimensional visualization of the complexity of the maxillofacial region.

MATERIAL AND METHODS

50 CRF patients and 50 healthy controls (26 men and 24 women in each of the patient group and control group) participated in the study. The median age for the patient and control groups was 29.64 years (range, 15 years to 48 years). The study comprised patients with glomerular filtration rates >60 ml min1, and the median time after starting dialysis was 43.21 months. The study excluded patients with hyperthyroidism, anaemia, diabetes mellitus, radiation, alcohol use, corticosteroid treatment, and a history of smoking. The healthy control group did not receive any new CBCT images. The control group was selected from the CBCT archive and had the same gender and age as the patient group. The control group's mean age was also the same as the patient groups.

The measurements were carried out on CBCT scans taken from patients with CRF and healthy controls. Ledgerton's classification on panoramic images was adjusted to CBCT measurements for the current investigation. On CBCT scans of patients with CRF and healthy controls, the antegonial index (AI), mental index (MI), panoramic mandibular index (PMI), and MCI values were assessed in the right and left mandibles. In order to determine the mandibular cortical thickness for MI, a line perpendicular to the mandible's bottom was drawn at the centre of the mental foramen. The PMI was determined by dividing the inferior mandibular cortex's distance from the mental foramen by the inferior mandibular cortex's thickness. The soft-tissue calcifications, pulp calcifications, pulp chamber size and lamina dura were also evaluated for patients with CRF and the controls. For determining soft-tissue calcifications, all of the axial slices were examined in the scanning area, and the detected cases were noted. Soft-tissue calcifications such as osteoma cutis, calcified stylohyoid chain, tonsillolithiasis, sialolithiasis and carotid artery calcifications were noted.

SPSS software was used to conduct the statistical analysis. The pulp chamber size, the number of teeth with pulp calcification, and lamina dura loss were all evaluated using the paired t-test, and the MI, AI, and PMI values were examined using the $\chi 2$ test. The MCI values were also examined. Statistics were considered significant when p 0.05 was present.

RESULTS

Patients with CRF and the control group shared the same age and gender variables. When compared to the healthy controls, there were no statistically significant variations between the MI, PMI, or AI of the CRF patients. Patients with CRF had MCIs with a more porous texture. Although there were 10% of CRF patients who had Class III MCI, there were none in the control group. The number of teeth with pulp calcifications and the size of the pulp chamber in patients with CRF compared to those in the control group did not differ in a statistically significant way. However, patients with CRF had a larger percentage of teeth with lamina dura loss (p 0.001). Additionally, CBCT was able to identify soft tissue calcifications, and there were noticeable differences between patients with CRF and the control group. For instance, 65% of patients with CRF had at least one soft tissue calcification, whereas only 29% of the control group did. Additionally, radiolucent abnormalities (brown tumours) were found in the jaws of 16 of the CRF patients (32%), but not in the control group's jaws.

Table 1: mean values of mental index, antegonial index, size of pulp chamber and lamina dura loss

Parameters	Patients with CRF		Control group	
Mental index (MI)	**Right** 4.73	**Left** 4.69	**Right** 4.23	**Left** 4.36
Antegonial index (AI)	**Right** 2.61	**Left** 2.59	**Right** 2.93	**Left** 2.89
Pulp chamber size	**Vertical** 1.24	**Horizontal** 1.09	**Vertical** 1.07	**Horizontal** 1.06
Lamina dura loss	23.64		10.21	

Table 2: Mandibular cortical index values of the patients with chronic renal failure (CRF) and the control group

Class	Number of subjects in CRF group	Number of subjects in control group
Class I	30	34
Class II	15	16
Class III	05	00
TOTAL	50	50

DISCUSSION

Osteoporosis is a progressive bone disease that is characterized by a decrease in bone mass and density. Renal insufficiency is one of the medical disorders that can lead to osteoporosis and renal osteodystrophy. Orofacial features of renal osteodystrophy are bone demineralization, decreased trabeculation, decreased thickness of cortical bone, ground glass appearance of bone, metastatic soft-tissue calcification, radiolucent giant cell and fibrocystic lesions, lytic areas of bone, jaw fracture and abnormal bone healing.[9]

Changes in the hormone mineral (Hormone-minerale) metabolism may lead to losses in the bone structure. The best-known examples of the metabolic bone losses are HPT, postmenopausal osteoporosis, and hypercortisonism. HPT is divided into two subgroups as primary and secondary. Secondary HPT is especially seen in patients with advanced renal failure.[10] In these patients, bone resorptions, Brown tumors, fractures and skeletal deformities are the basic (main) clinical findings considerably influencing the life quality and lifetimes of the affected patients.[11,12]Only male patient and control groups were included in this study to prevent the effect of the hormonal changes in the menopausal period on the bone metabolism. Bone resorptions and calcifications can easily be determined in panoramic radiograms.[13] Panoramic radiographs are used to view the pathologies and cortical bone losses in jaws and teeth in the presence of chronic renal failure.[14]

Hence, this study was conducted to assess the radiographic manifestations of teeth and jaw bones in chronic renal failure patients.

In this study, patients with CRF and the control group shared the same age and gender variables. When compared to the healthy controls, there were no statistically significant variations between the MI, PMI, or AI of the CRF patients. Patients with CRF had MCIs with a more porous texture. Although there were 10% of CRF patients who had Class III MCI, there were none in the control group. The number of teeth with pulp calcifications and the size of the pulp chamber in patients with CRF compared to those in the control group did not differ in a statistically significant way. However, patients with CRF had a larger percentage of teeth with lamina dura loss (p 0.001). Additionally, CBCT was able to identify soft tissue calcifications, and there were noticeable differences between patients with CRF and the control group. For instance, 65% of patients with CRF had at least one soft tissue calcification, whereas only 29% of the control group did. Additionally, radiolucent abnormalities (brown tumours) were found in the jaws of 16 of the CRF patients (32%), but not in the control group's jaws.

P N Scutellari et al[15] conducted a study in which forty-five patients affected with chronic renal failure (29 men and 16 women; mean age: 47.8 years), treated with hemodialysis for 4 to 245 months (mean: 66.9 months) were examined with panoramic and skeletal radiographs-the latter of the skull, hands, shoulders and clavicles, pelvis and spine. The control group (45 subjects with no renal diseases) was examined only with panoramic radiography. Dental and skeletal radio-graphs were given an 0-6 score and then compared to assess a possible relationship between skeletal and dental changes at radiography. Twenty-six dialysis patients (57.7%) had radiographic abnormalities in the maxillary bones-i.e., osteoporosis (100% of patients), focal osteosclerosis adjacent to the roots (11.5%), lamina dura reduction or loss (26.9%), calcifications of soft tissues or salivary glands (15.3%) and brown tumors (7.6%). In the teeth of dialysis patients, the dental pulp chamber was narrowed in 11.1% and hypercementosis of the roots was observed in 4.5%. Radiographic abnormalities in the hand, shoulder and pelvis were depicted in 51.1% of dialysis patients-in 86.9% of them with maxillary lesions. In the control group, 15.5% had mandibular bone lesions-i.e., osteopenia, cortex reduction at the mandibular angles and cyst-like lesions -but the evidence of caries and periodontal disease did not differ from that in the dialysis group.

In a study that consisted of only 90 male individuals (30 patient and 60 control), ground-glass appearance was observed in 30% of the secondary HPT patients, but no appearance was found in the control group.[16] No lesions with ground-glass appearance were encountered in the study conducted on the patient group including 12 patients with chronic renal failure. In the study implemented by Henriques et al.[17] on the patient with chronic renal failure, no pathologies with ground-glass appearance were discovered. Padbury et al.[18] did not discover any pathology with a ground-glass appearance in their study that included HPT patients. In our study, ground-glass appearance was encountered only in one patient, but not seen in the control group. Parathyroid hormone value of this patient was 1000 pg/ml, and parathyroid adenoma was detected in this patient.

CONCLUSION

In patients with CRF, radiographic abnormalities in the jawbones may frequently be observed. When evaluating osseous findings, pulp chambers, soft-tissue calcifications, and MCIs, CBCT is a useful diagnostic tool since it enables determination of indices in three dimensions devoid of superposition.

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