

Changes in jawbones of male patients with chronic renal failure on digital panoramic radiographs

Saadettin Dagistan¹, Ozkan Miloglu¹, Fatma Caglayan¹

Correspondence: Dr. Ozkan Miloglu
Email: omiloglu@hotmail.com

¹Department of Maxillofacial Radiology, Faculty of Dentistry, Ataturk University, Erzurum, Turkiye

ABSTRACT

Objective: To compare the existence of gonial cortical bone thickness, antegonial index, mandibular canal bone resorption and gonial angle values and pathologies like ground-glass appearance in jawbones and brown tumor in male patients undergoing dialysis due to chronic renal failure and men from the healthy control group on panoramic radiographs. **Materials and Methods:** Panoramic radiographs were taken from 80 male individuals in total (40 normal and 40 dialysis patients). Values obtained from the right and left sides of the mandible were summed and their means were calculated. Gonial cortical thickness, antegonial index and gonial angle values were assessed with the Student's *t*-test, mandibular canal wall resorption with the Chi-square test, and pathologies such as ground-glass appearance and Brown tumor as "available" or "not available." **Results:** Statistically significant differences were observed among the antegonial index ($P < 0.001$), gonial cortical bone thickness ($P < 0.001$), and gonial angle ($P < 0.001$) values of study and control groups. Besides, mandibular canal wall resorption ($P < 0.001$) was also statistically significant. In the study group, pathologies with ground-glass appearance were encountered in mandible, but no radiographic findings were observed similar to brown tumor. **Conclusions:** Compared to the control group, decreases were found in gonial cortical bone thicknesses, antegonial index values, mandibular canal wall resorption, and gonial angle values of the patients receiving dialysis treatment due to chronic renal failure. Although it is not statistically significant, pathology with ground-glass appearance was detected in a patient, but no pathologies like brown tumor were observed. These findings from patients with chronic renal failure must be evaluated in panoramic radiography.

Key words: Brown tumors, chronic renal failure, dialysis, fibrous dysplasia, mandibular bone

INTRODUCTION

One of the significant functions of the kidney is regulatory impact on the bone metabolism by enabling active Vitamin D production. Hypocalcemia arises as a result of phosphate retention and calcium loss in kidneys in chronic renal failure; this situation stimulates parathyroid hormone release and leads to secondary hyperparathyroidism (HPT). Low serum calcium and high phosphate concentration cause progressive bone loss with calcium release from bone by increasing the osteoclastic activity. Thus, skeletal changes occur.^[1]

Parathyroid hormone is defined as tunnel resorption, the earliest finding of osteoclastic response.^[2] This situation does not show any indications in conventional radiographies. First radiographic changes are seen as intracortical and sub-endosteal resorption areas.^[3] The earliest radiographic indication related to jawbones

is the ground-glass appearance that emerges due to the replacement of the bone tissue by the connective tissue with cortical bone resorption, lamina dura, and trabecular bone loss.^[4] As a consequence of long-lasting HPT, osteitis fibrosa cystica or skeletal radiolucency areas are called as Brown tumor development.^[5]

The aim of this study was to compare the existence of gonial cortical bone thickness, antegonial index, mandibular canal bone resorption, gonial angle values,

This is an open access article distributed under the terms of the Creative Commons Attribution-NonCommercial-ShareAlike 3.0 License, which allows others to remix, tweak, and build upon the work non-commercially, as long as the author is credited and the new creations are licensed under the identical terms.

For reprints contact: reprints@medknow.com

How to cite this article: Dagistan S, Miloglu O, Caglayan F. Changes in jawbones of male patients with chronic renal failure on digital panoramic radiographs. *Eur J Dent* 2016;10:64-8.

DOI: 10.4103/1305-7456.175699

and pathologies like ground-glass appearance in jawbones and brown tumor in male patients undergoing dialysis due to chronic renal failure and men from the healthy control group on panoramic radiographs.

MATERIALS AND METHODS

Study population

The study consisted of 40 male dialysis patients ([ages between 20 and 77, mean 47.30, standard deviation 15.20] [dialysis duration between 168 months and 4 months, mean 57.10 months and standard deviation 53.75]), who were sent from Atatürk University, Faculty of Medicine, Department of Nephrology to Atatürk University, Faculty of Dentistry, Oral Diagnosis and Radiology Clinic because of their dental problems, and the healthy control group of 40 men (ages varying between 21 and 76, mean 44.55, standard deviation 13.56) who came to our clinic due to various dental problems and had no systemic diseases; 80 individuals in total. Approval was obtained from the Ethics Committee.

Imaging procedure

All radiographs were performed by radiography technicians who had a minimum working experience of 5 years using an orthopantomography device (Planmeca Promax FIN-00880 [Helsinki, Finland]) and in compliance with the reference points on the device given by the manufacturer.

Image evaluation

The images were examined by two investigators (both of them, associated professor) at the same time. To check for the diagnostic reproducibility of the inter-reliability of the two investigators, 10% of the radiographs assigned by them were randomly examined each day for 3 consecutive days. Examination of results using the Wilcoxon matched pairs signed-rank test showed no statistically significant differences between the two observers, indicating diagnostic reproducibility. In addition, 10% of the remaining radiographs were selected at random and re-evaluated twice by the same examiners 6 weeks after the first evaluation. Intraexaminer reproducibility was found to be 96% and 90%, respectively. Gonial cortical bone thickness [Figure 1-d], antegonial index [Figure 1-c], and gonial angle [Figure 2-a] measurements were conducted on right and left sides of the mandible separately, and average values were calculated. Mandibular canal wall resorption [Figure 2-b] was separately examined on the right and left sides of the mandible; the ground-glass appearance [Figure 3]



Figure 1: c - Antegonial index. The cortical width in the region anterior to the gonion at a point identified by extending a line of "best fit" on the anterior border of the ascending ramus, down to the lower border of the mandible; d - gonial cortical bone thickness. The median projection on angulus mandibula bisector of the angle from the parts formed tangents to rear edge of the ramus and to lower edge of the mandible on the orthopantomography

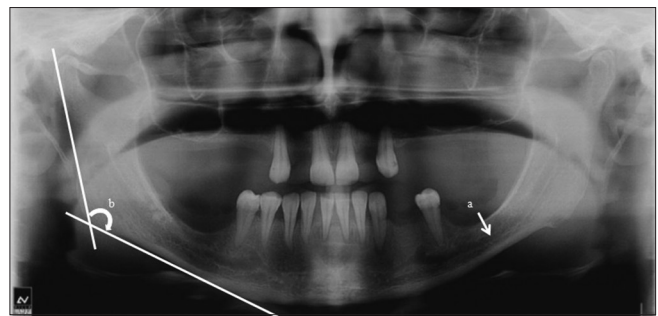


Figure 2: a - Gonial angle measurement. The measurement site in the radiograph was determined to be a point on the mandibular border at the intersection of a line tangential to the most inferior points at the mandibular angle and the lower border of the mandibular body, and a line tangential to the posterior borders of the ramus and the condyle; b - mandibular canal wall resorption

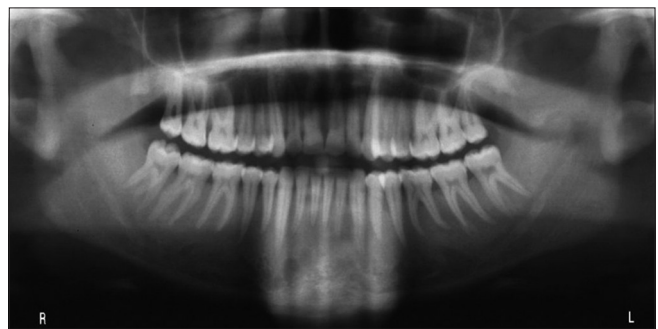


Figure 3: Ground-glass appearance

and brown tumor were checked both in maxillary and mandibular bone.

Statistical analysis

The statistical analyses were assessed with the Student's *t*-test according to the heterogeneity of the variances, mandibular canal wall resorption with the Chi-square test, and pathologies such as ground-glass appearance and Brown tumor as "available" or "not available."

RESULTS

There were statistically important differences between the antegonial index ($t = 7.00$, $P < 0.001$) values of dialysis patients and the control group. Similarly, statistically important differences were observed between the two groups in terms of gonial cortical bone thickness ($t = 8.26$, $P < 0.001$) and gonial angle ($t = 5.13$, $P < 0.001$) values.

Mandibular canal wall resorption ($\chi^2 = 8.26$ $P < 0.001$) was found statistically significant and the difference emerged as 77.5% in the patient group and 5% in the control group.

Pathology with ground-glass appearance was detected only in one individual from the patient group, and no pathologies like Brown tumor were encountered.

Average antegonial index values of the dialysis and control group individuals are given in Table 1, their average gonial cortical bone thickness values in Table 2, average gonial angle values in Table 3, and mandibular canal wall resorption values in Table 4.

DISCUSSION

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.^[6] 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.^[7,8] 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.^[9] Panoramic radiographs are used to view the pathologies and cortical bone losses in jaws and teeth in the presence of chronic renal failure.^[10]

Gonial cortical bone thickness <1 mm was interpreted as the radiographic indication of metabolic bone diseases.^[7,11] In a study conducted with 59 (39 HPT and 20 control) individuals, a decrease was observed in the gonial cortical bone thickness in panoramic

Table 1: Antegonial index value of dialysis patients and the control group

	Mean	SD	Minimum	Maximum	t	P
Dialysis	3.00	1.05	1.00	5.00	7.00	0.0001
Control	4.41	0.72	3.50	6.00		

SD: Standard deviation

Table 2: Gonial cortical bone thickness measurements of dialysis patients and the control group

	Mean	SD	Minimum	Maximum	t	P
Dialysis	0.58	0.79	0.00	2.00	8.28	0.0001
Control	1.86	0.55	1.00	2.50		

SD: Standard deviation

Table 3: Gonial angle of dialysis patients and the control group

	Mean	SD	Minimum	Maximum	t	P
Dialysis	125.00	6.20	117.00	140.00	5.13	0.0001
Control	118.00	5.24	107.00	125.00		

SD: Standard deviation

Table 4: Mandibular canal wall resorption of dialysis patients and the control group values

	n	Right mandible	Left mandible	Totally	Percentage
Dialysis	80	38	24	62	77.5
Control	80	2	2	4	5.0

radiographs of the patient group.^[12] Gonial cortical bone thickness was found thinner than that of healthy individuals in a study made on a patient group with chronic renal failure.^[6] It was specified that the gonial cortical bone thickness was thinner in systemic osteoporosis as well.^[8] In another study, the gonial cortical bone thickness was found <1 mm.^[13] Gavaldá *et al.*^[14] stated in their study that the gonial cortical bone was thinner in hemodialysis patients. In our study, the gonial cortical bone thickness was thinner in patients with renal failure compared to the control group, and it corresponded to the present studies.

Mandibular canal is mostly seen as radiolucency line that has a uniform width and borders as it surrounded by radiopaque walls.^[15] Vertical localization and status of the canal can be determined in panoramic radiographs.^[13] Mandibular canal wall resorption was observed only in one of 38 patients in the study conducted by Kelly *et al.*^[16] Gavaldá *et al.*^[14] revealed in their study that there were mandibular canal wall resorptions in hemodialysis patients. Kim and Park^[17] observed a complete or partial loss on the mandibular canal walls of 8 patients in their study including 31 secondary

HPT patients, who underwent dialysis. In our study, mandibular canal wall resorption was encountered in 64 of 80 canals that belonged to 40 patients, and higher values were found compared to the present studies. Mandibular canal wall resorption studies were also carried out on different groups apart from renal disease. It was suggested in a study conducted on 128 men and women that the upper wall of the mandibular canal was more resorbed in edentulous women than edentulous men and canal wall resorptions could also be observed in systemic situations such as senility, asthma, and thyroid diseases.^[13]

No studies were discovered in the literature regarding the antegonial index in digital panoramic radiograms of the patients that underwent dialysis due to chronic renal failure. Rai *et al.*^[18] found a statistically significant difference between the antegonial index values in their study including 26 HPT patients and a healthy control group. However, Padbury *et al.*^[19] could not find any statistically significant difference between the antegonial index values in their study including 39 HPT patients and a healthy control group. In our study, a significant difference was found between dialysis patients and the control group in terms of antegonial index values. In addition, important differences were observed between the control group and patient group in many studies conducted on the mandibular cortical bones of the patient groups with chronic renal failure. It was specified that the cortical bones of the patient group were thinner.^[1,11]

It was also stated that panoramic radiograms were a useful tool for measuring the mandibular gonial angles.^[20] Only one study was encountered in the literature regarding the mandibular gonial angle measurements of the patients with chronic renal failure. In this study, which had groups separated between the ages of 5 and 16 and was conducted through comparisons between 23 patients with chronic renal failure and control group, a decrease was observed in the gonial angle values in the 5–14 aged patient group and an increase in the gonial angle values of the 14–16 aged patient group.^[21] There was an important difference between the gonial angle values of the patient and control groups in our study. This difference may have resulted from the fact that gonial cortical bone thickness was thinner in the patient group. All the same, many studies were carried out between dentate-edentulous individuals, genders and different age groups. While no significant difference was found in gonial angle values in a group of studies,^[22,23] significant differences were detected in others.^[24,25]

Brown tumors emerge as a result of both primary and secondary HPT and secondary HPT is generally resulted from chronic renal failure. It has been determined that Brown tumor develops in 1.5–1.7% of the secondary HPT patients.^[26] Brown tumor is encountered in women 3 times more often than men.^[27] In a study conducted on 30 patients, who had received dialysis treatment for at least 3 years, Brown tumor was discovered in 4 patients,^[12] and radiolucency lesions that reminded of Brown tumor were observed in 2 of 38 patients in a study made by Kelly *et al.*^[16] The brown tumor development was seen only in one patient in the study, which was conducted by Queiroz *et al.*^[28] on 174 hemodialysis patients. Vidyullatha *et al.*^[29] found multiple small radiolucency areas in the posterior mandible of 2 patients in the study they implemented on 40 dialysis patients, and Brown tumor was detected in a patient from the patient group in a study that included 26 primary HPT patients and a control group.^[16] No Brown tumors were encountered in 74 patients with renal failure in the study made by Shakibaei *et al.*^[30] Henriques *et al.*^[11] could not determine Brown tumors in studies they conducted on HPT patients. No Brown tumors were seen in the study of Rani,^[31] too. In our study, no Brown tumors or similar pathologies were observed in patients and control groups. This situation may have arisen from the patient gender we chose.

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.^[11] No lesions with ground-glass appearance were encountered in the study conducted on the patient group including 12 patients with chronic renal failure.^[6] In the study implemented by Henriques *et al.*^[12] on the patient with chronic renal failure, no pathologies with ground-glass appearance were discovered. Padbury *et al.*^[19] 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.

CONCLUSIONS

Pathologies with ground-glass appearance, brown tumors and cortical bone losses that emerge in the jawbones of the patients receiving dialysis treatment

due to chronic renal failure can be evaluated in digital panoramic radiograms.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

REFERENCES

- Raubenheimer EJ, Noffke CE, Hendrik HD. Chronic kidney disease-mineral bone disorder: An update on the pathology and cranial manifestations. *J Oral Pathol Med* 2015;44:239-43.
- Eknoyan G, Lameire N, Barsoum R, Eckardt KU, Levin A, Levin N, *et al.* The burden of kidney disease: Improving global outcomes. *Kidney Int* 2004;66:1310-4.
- Meema M, Meema S. Microscopic quantitation of periosteal resorption in secondary hyperparathyroidism of chronic renal failure. *Clin Orthop* 1978;130:197-202.
- Martin A, David V, Quarles LD. Regulation and function of the FGF23/klotho endocrine pathways. *Physiol Rev* 2012;92:131-55.
- Matsushige T, Nakaoka M, Yahara K, Kagawa K, Miura H, Ohnuma H, *et al.* Giant cell tumor of the temporal bone with intratumoral hemorrhage. *J Clin Neurosci* 2008;15:923-7.
- Bras J, van Ooij CP, Abraham-Inpijn L, Wilmink JM, Kusen GJ. Radiographic interpretation of the mandibular angular cortex: A diagnostic tool in metabolic bone loss. Part II. Renal osteodystrophy. *Oral Surg Oral Med Oral Pathol* 1982;53:647-50.
- Hansen D, Brandt L, Rasmussen K. Treatment of secondary hyperparathyroidism in haemodialysis patients: A randomised clinical trial comparing paricalcitol and alfacalcidol. *BMC Nephrol* 2009;10:28.
- El-Kishawi AM, El-Nahas AM. Renal osteodystrophy: Review of the disease and its treatment. *Saudi J Kidney Dis Transpl* 2006;17:373-82.
- Koizumi M, Komaba H, Nakanishi S, Fujimori A, Fukagawa M. Cinacalcet treatment and serum FGF23 levels in haemodialysis patients with secondary hyperparathyroidism. *Nephrol Dial Transplant* 2012;27:784-90.
- Asaumi J, Aiga H, Hisatomi M, Shigehara H, Kishi K. Advanced imaging in renal osteodystrophy of the oral and maxillofacial region. *Dentomaxillofac Radiol* 2001;30:59-62.
- Henriques JC, de Melo Castilho JC, Jacobs R, Amorim JB, Rosa RR, Matai CV. Severe secondary hyperparathyroidism and panoramic radiography parameters. *Clin Oral Investig* 2014;18:941-8.
- Henriques JC, Castilho JC, Jacobs R, Amorim JB, Rosa RR, Matai CV. Correlation between hand/wrist and panoramic radiographs in severe secondary hyperparathyroidism. *Clin Oral Investig* 2013;17:1611-7.
- Xie Q, Wolf J, Tilvis R, Ainamo A. Resorption of mandibular canal wall in the edentulous aged population. *J Prosthet Dent* 1997;77:596-600.
- Gavaldá C, Bagán J, Scully C, Silvestre F, Milián M, Jiménez Y. Renal hemodialysis patients: Oral, salivary, dental and periodontal findings in 105 adult cases. *Oral Dis* 1999;5:299-302.
- Jover Cerveró A, Bagán JV, Jiménez Soriano Y, Poveda Roda R. Dental management in renal failure: Patients on dialysis. *Med Oral Patol Oral Cir Bucal* 2008;13:E419-26.
- Kelly WH, Mirahmadi MK, Simon JH, Gorman JT. Radiographic changes of the jawbones in end stage renal disease. *Oral Surg Oral Med Oral Pathol* 1980;50:372-81.
- Kim EK, Park TW. Maxillo-mandibular radiographic evaluation of renal osteodystrophy. *Oral Radiol* 1991;7:13-9.
- Rai S, Bhadada SK, Rattan V, Bhansali A, Rao DS, Shah V. Oro-mandibular manifestations of primary hyperparathyroidism. *Indian J Dent Res* 2012;23:384-7.
- Padbury AD Jr., Tözüm TF, Taba M Jr., Ealba EL, West BT, Burney RE, *et al.* The impact of primary hyperparathyroidism on the oral cavity. *J Clin Endocrinol Metab* 2006;91:3439-45.
- Alhaja ES. Panoramic radiographs: Determination of mandibular steepness. *J Clin Pediatr Dent* 2005;29:165-6.
- Al-Thomali Y, El-Bialy TH. Cephalometric craniofacial features of growing patients with chronic renal failure. *Arch Oral Biol* 2012;57:257-63.
- Joo JK, Lim YJ, Kwon HB, Ahn SJ. Panoramic radiographic evaluation of the mandibular morphological changes in elderly dentate and edentulous subjects. *Acta Odontol Scand* 2013;71:357-62.
- Ceylan G, Yanikoglu N, Yılmaz AB, Ceylan Y. Changes in the mandibular angle in the dentulous and edentulous states. *J Prosthet Dent* 1998;80:680-4.
- Ohm E, Silness J. Size of the mandibular jaw angle related to age, tooth retention and gender. *J Oral Rehabil* 1999;26:883-91.
- Xie QF, Ainamo A. Correlation of gonial angle size with cortical thickness, height of the mandibular residual body, and duration of edentulism. *J Prosthet Dent* 2004;91:477-82.
- Keyser JS, Postma GN. Brown tumor of the mandible. *Am J Otolaryngol* 1996;17:407-10.
- De la Rosa García E, Mondragón Padilla A, Aranda Romo S, Bustamante Ramírez MA. Oral mucosa symptoms, signs and lesions, in end stage renal disease and non-end stage renal disease diabetic patients. *Med Oral Patol Oral Cir Bucal* 2006;11:E467-73.
- Queiroz MS, Amorim AG, de Andrade AL, Gordón-Núñez MA, de Almeida Freitas R, Cavalcanti Galvão H. Influence of dialysis duration and parathyroid hormone on the clinical and radiographic oral conditions of pre-transplant patients with chronic kidney disease. *Braz J Oral Sci* 2013;12:125-31.
- Vidyullatha BG, Ali IM, Shashikanth MC, Praveen BS. Oral manifestations and radiographic changes in the jaw-bones of patients with end-stage renal disease on maintenance hemodialysis – A descriptive study. *Arch Oral Res* 2011;7:119-27.
- Shakibaei Z, Tohidi E, Gholiyaf M, Garmrudi B, Garmrudi E. Dentomaxillofacial radiographic changes in a group of Iranian patients with end stage renal disease undergoing hemodialysis. *J Dent Mater Tech* 2014;3:180-7.
- Rani SH. Radiological manifestations in patients of chronic renal insufficiency under different modalities of treatment. *J Pharm Biomed Sci* 2013;26:397-405.

Access this article online

Quick Response Code:



Website:
www.eurjdent.com