



Oral manifestations and radiographic changes in the jaw-bones of patients with end-stage renal disease on maintenance hemodialysis – A descriptive study

Estudo descritivo das manifestações bucais e alterações radiográficas em maxilares de pacientes com doença renal terminal e sob hemodiálise

Vidyullatha BG^[a], Ali IM^[b], Shashikanth MC^[c], Praveen BS^[d]

^[a] MDS, reader at Department of Oral Medicine and Radiology, Hitkarini Dental College and Hospital, Jabalpur, Dumna Road, Madhya Pradesh - India, e-mail: vidyu_krishna@yahoo.com

^[b] MDS, professor at Department of Oral Medicine and Radiology, College of Dental Sciences, Davangere, Karnataka - India.

^[c] MDS, professor and head at Department of Oral Medicine and Radiology, U.P. Dental College and Research Centre, Lucknow, Uttar Pradesh - India.

^[d] MDS, MOrth RCSEd, reader at Department of Orthodontics, Hitkarini Dental College and Hospital Dumna Road, Jabalpur, Madhya Pradesh - India.

Abstract

Objectives: The purpose of the present study was to assess the oral manifestations and radiographic changes in the jawbones of patients undergoing hemodialysis, diagnosed with end-stage renal disease (ESRD). **Methods:** Forty patients on maintenance hemodialysis were clinically examined for oral manifestations and evaluated for radiographic changes in the jaws with panoramic and intra-oral periapical radiographs. Results were expressed as Percentage. **Results:** Out of 40 patients, 37 patients (92.5%) showed at least one or more oral manifestations. The most common oral manifestations were mucosal pallor (70%), xerostomia (57.5%), petechiae and ecchymoses (37.5%), and less common were taste alterations (15%), uremic odor (7.5%), coated tongue (10%) and mucosal pain (2.5%). Radiographic changes seen were loss of lamina dura (22.2%), altered trabecular pattern (5.5%), multiple radiolucent lesions (5%), and pulp calcification (2.7%). **Conclusions:** Most of the patients presented with oral signs and symptoms. However it was observed that patients demonstrating radiographic changes were mostly those who were on dialysis for a relatively long duration.

Keywords: ESRD. Hemodialysis. Oral manifestations. Renal osteodystrophy.

Resumo

Objetivos: O objetivo do presente estudo foi avaliar as manifestações orais e alterações radiográficas nos maxilares de pacientes submetidos à hemodiálise e com diagnóstico de doença renal em estágio terminal (DRET).

Métodos: 40 pacientes em hemodiálise de manutenção foram examinados clinicamente e avaliados radiograficamente por meio de radiografias panorâmicas e periapicais em busca de manifestações orais nas mandíbulas.

Resultados: Dos 40 pacientes, 37 pacientes (92,5%) apresentaram pelo menos uma ou mais manifestações orais. As manifestações orais mais comuns foram: palidez da mucosa (70%), xerostomia (57,5%), petéquias e equimoses (37,5%); e menos comuns: alterações do paladar (15%), odor urêmico (7,5%), língua saburrosa (10%) e mucosa dolorida (2,5%). As alterações radiográficas observadas foram a perda da lâmina dura (22,2%), padrão trabecular alterado (5,5%), lesões radiolúcidas múltiplas (5%) e calcificação pulpar (2,7%). **Conclusões:** A maioria dos pacientes apresentava sinais e sintomas orais. Entretanto, foi observado que os pacientes demonstrando alterações radiográficas foram principalmente aqueles que estavam em diálise por um período relativamente longo

Palavras-chave: DRET. Hemodiálise. Manifestações orais. Osteodistrofia renal.

Introduction

End-stage renal disease (ESRD) is the final common pathway of numerous kidney diseases, which ultimately causes death unless treated by dialysis or renal transplant (1). ESRD patients eventually develop a clinical syndrome known as *uremia*, which affects virtually every organ system including craniofacial complex and oral cavity (2, 3).

Improvement in dialysis is extending the life expectancy of the affected patient population (4, 5), but dialysis does not provide the same degree of health as normally functioning kidneys (6). Hence some of the underlying pathologies continue to progress (7). Very few studies have been done to evaluate the oral and radiographic manifestations secondary to these pathologic processes in these patients. Therefore the present study was aimed to assess the oral manifestations and radiographic changes in the jawbones of forty ESRD patients on maintenance hemodialysis.

Methodology

Forty patients suffering from end-stage renal disease undergoing hemodialysis at Bapuji Hospital, Davangere, India were included in the present study. The clearance to conduct this study was provided by the institutional ethical board, which has been kept in the archives of the College of Dental Sciences, Davangere, Karnataka, India. The patients signed an informed consent which has been kept

in the archives of the College of Dental Sciences, Davangere, Karnataka, India.

The patients were selected based on the following criteria.

Inclusion criteria:

- 1) Patients diagnosed with end stage renal disease on maintenance hemodialysis.

Exclusion criteria:

- 1) Patients diagnosed with Acute renal failure;
- 2) Patients who had undergone renal transplantation.

A comprehensive oral examination of soft and hard tissue was done in all patients. Each patient was examined clinically for the presence/absence of any soft or hard tissue lesion with special attention towards certain manifestations which have appeared in the literature. The patients were questioned about dry mouth (xerostomia), taste changes, any other oral symptoms and examined for oral changes such as uremic odor, uremic stomatitis, mucosal pallor, petechiae and/or ecchymoses, coated tongue and any other mucosal changes.

Each individual included in the study was subjected to standard panoramic radiography. Additional intraoral periapical radiographs were taken only when felt necessary to evaluate any suspected radiographic changes. The radiographs were evaluated by two blinded independent examiners for

alterations in lamina dura, trabecular pattern, size of the pulp chambers, and also evaluated for radiolucent lesions and any other miscellaneous findings. Radiographs were graded according to the criteria mentioned in Table 1. Teeth with gross carious lesions and periodontal problems, severe attrition, erosions which were suspicious to have evoked pulpal and/or periapical pathologies were not considered for the evaluation of parameters like loss of lamina dura, alterations in the trabecular pattern and presence of pulp calcifications.

Results

The age of the patients ranged from 21 years to 80 years with mean age of 48.3 years. Among them thirty four were male and six were female subjects. The duration of hemodialysis ranged between 15 days to 40 months with a mean duration of 8.2 months. The duration of hemodialysis and etiology of ESRD in these patients are presented in Table 2 and Table 3 respectively.

Table 1 - Criteria for radiographic assessment – Modified from the criteria given by Kelly et al. (1)

Parameters	Radiographic appearance	Grading
Lamina dura	Entire lamina dura substantially thickened	+2
	Portions of Lamina dura thickened; milder degrees	+1
	Within normal limits	0
	Lamina dura substantially thinned; missing in some areas	-1
	Lamina dura essentially absent; may be present in isolated area	-2
Trabecular pattern	All trabeculae substantially coarser	+2
	Some coarser trabeculae; milder degrees	+1
	Within normal limits	0
	Delicate finely meshed trabeculations	-1
Pulp chambers	Granular, nearly homogenous patterns; individual trabeculations essentially absent	-2
	Severe increase in pulp chamber size	+2
	Mild to moderate increase in pulp chamber size	+1
	Within normal limits	0
	Mild to moderate decrease in pulp chamber size	-1
Radiolucent lesions (not associated with teeth)	Pulp chambers essentially absent	-2
		Present/absent
Others		Present/absent

Source: Research data.

Table 2 - Duration of hemodialysis

	No. of subjects	Duration of hemodialysis (in months)		
		Mean ± SD*	Median	Range
Male	34	9.3 ± 10.7	3.5	0.5 to 40
Female	6	1.2 ± 0.6	1.0	0.5 to 2
Total	40	8.2 ± 10.3	2.5	0.5 to 40

Note: *SD = Standard Deviation.

Source: Research data.

Table 3 - Etiology of ESRD

Etiology	Number of subjects
Diabetes mellitus	22
Hypertension	10
Polycystic kidney disease	4
Chronic glomerulonephritis	2
Interstitial nephritis	1
IgA nephropathy	1

Source: Research data.

Out of 40 patients, 37 patients (92.5%) showed at least one or more oral manifestations. Twenty-three (57.5%) reported of subjective symptoms and 32 patients (80%) demonstrated objective findings. Symptoms reported were dry mouth by 23 patients (57.5%), taste alteration by 6 patients (15%), and mucosal pain by 1 patient (2.5%). Objective findings seen were mucosal pallor in 28 patients (70%), petechiae and/or ecchymoses in 15 patients (37.5%), and coated tongue in 4 patients (10%). Uremic odor was present in 3 patients (7.5%). Miscellaneous findings were hematoma, anemic glossitis and angular cheilitis in one patient each (2.5%) (Table 4). None demonstrated uremic stomatitis or oral ulcerations.

Among the radiographic changes, parameters such as loss of lamina dura, alterations in the trabecular pattern, calcification of pulp chambers could not be assessed in 4 partially edentulous patients who had less than ten teeth which were either periodontally compromised or grossly carious. So out of 36 patients, thinning or loss of lamina dura was observed in 8 patients (22.2%), alterations in trabecular pattern in 2 patients (5.5%) and pulp calcifications in one patient (2.7%). Radiographic evaluation of jaws showed multiple discrete radiolucent lesions [lesions more than two in number, not of periapical/periodontal/pericoronar origin, and distributed in a discrete fashion] in two (5%) of 40 patients and panoramic radiograph of one patient (2.5%) revealed a miscellaneous finding of stylohyoid ligament calcification bilaterally (Table 5).

Discussion

The present study assessed the oral manifestations in ESRD patients undergoing hemodialysis to observe the relative frequency of oral signs and symptoms that have appeared in the literature (3, 4, 5). Few studies have assessed the oral and radiographic manifestations in ESRD patients on maintenance hemodialysis. Few studies have assessed the oral and radiographic manifestations in ESRD patients on maintenance hemodialysis (Table 6).

Table 4 - Oral manifestations seen in the subjects

Oral manifestations	No. of subjects manifesting the changes (out of 40 patients)	Percentage (%)	
Subjective symptoms	Dry mouth	23	57.5
	Taste alterations	6	15
	Others: mucosal pain	1	2.5
Objective findings	Mucosal pallor	28	70
	Petechiae/Ecchymoses	15	37.5
	Increased tongue coating	4	10
	Uremic odor	3	7.5
	Uremic stomatitis	None	-
	Others: hematoma following minor trauma, anemic glossitis, angular cheilitis	2	5

Source: Research data.

Table 5 - Radiographic changes in the jawbones

Radiographic changes	No. of subjects manifesting the changes	Percentage (%)
Loss of lamina dura (assessed in 36 patients)	8	22.2
Altered trabecular pattern (assessed in 36 patients)	2	5.5
Radiolucent lesions (assessed in all 40 patients)	2	5.0
Pulp calcifications (assessed in 36 patients)	1	2.7
Others: bilateral stylohyoid ligament calcification (assessed in all 40 patients)	1	2.5

Source: Research data.

In the present study, more than 90% of the patients showed at least one or more oral signs and symptoms. Among the subjective symptoms, xerostomia was reported by 23 patients (57.5%). Xerostomia in ESRD patients is caused by a combination of direct uremic involvement of the salivary glands, chemical inflammation and dehydration due to restricted fluid intake (8). It is of interest to note that 18 of 23 patients who reported xerostomia were diabetics attributing further to the higher incidence of this symptom (9). Impaired taste perception was reported by 6 patients (15%). Most patients with this symptom were elderly with a mean age of 64.5 years. Slower renewal of taste buds in geriatric patients (10) in addition to intake of protein restricted diet might have led to an altered taste perception. One patient (2.5%) reported oral mucosal pain, where clinical examination did not reveal any abnormality. Accumulation of ammonia and other toxins might irritate the oral mucosa resulting in such symptoms (11).

Table 6 - Studies of oral and radiographic manifestations in ESRD patients on maintenance hemodialysis

Studies	Subjective symptoms				
	Dry mouth	Altered taste	Tongue/mucosal pain		
Kho et al. (11)	32.9%	31.7%	12.2%		
Chuang et al. (3)	4.24 ± 1.73† (ND)*	3.72 ± 2.44 (ND)	4.22 ± 2.00 (ND)		
	5.07 ± 1.56 (DB)**	5.48 ± 2.56 (DB)	5.36 ± 1.99 (DB)		
	Objective findings				
	Uremic odor	Coated tongue	Petechiae/ecchymoses	Oral ulceration	
Kho et al. (11)	34.1%	12.2%	12.2%	1.2%	
Chuang et al. (3)	49.4% (ND)	47.1% (ND)	22.4% (ND)	1.2% (ND)	
	27.9% (DB)	39.5% (DB)	20.9% (DB)	0% (DB)	
	Radiographic findings				
	Lamina dura***	Trabeculation	Overall density	Pulp chambers	Radiolucent lesions
Kelly et al. (1)	Thinned and/lost in 53%	Altered in 37%	Increased in 16%	Moderate reduction in the size in 10.5%	Radiolucent lesions not associated with teeth seen in 5.2%

Note: † Mean ± Standard deviation, where n = 85 for non diabetics and n = 43 for diabetics

*Other studies showing thinned and/or loss of lamina dura include Rivas et al. - 74 %, Spolnik et al. - 45 %, Amann et al. - 60 % and Rosenberg et al. - 40 % as mentioned by Kelly et al. (1).

Source: Research data.

Among the objective findings, 28 patients (70%) exhibited mucosal pallor, one patient each presented glossitis and angular cheilitis, attributable to anemia which is commonly seen in ESRD patients (6, 12). 15 patients (37.5%) had petechiae and ecchymoses (Figure 1). one patient presented hematoma following minor tooth brush injury (Figure 2). Although the etiology is multifactorial bleeding tendencies, petechiae or ecchymoses result mainly from an acquired qualitative platelet defects secondary to uremic toxins that decrease platelet adhesiveness. In addition heparinization may also contribute for the bleeding tendencies (8).

Coated tongue was seen in 4 patients (10%) attributable to lack of oral health care in these individuals, where attention tends to center on the severe underlying systemic condition (13). Uremic odor was observed in 3 patients (7.5%). Several changes occur in the oral cavity which are associated with chronic renal failure and uremia. ne of the earliest symptoms may be a bad taste and odor in the mouth, particularly in the morning. This uremic fetor, an ammoniacal odor, is typical of any uremic patient and is caused by the high concentration of urea in the saliva and its subsequent breakdown to ammonia (6, 8).

None of the subjects in the present study showed uremic stomatitis, and oral ulcerations. McCreary et al. (14) presented a case of uremic stomatitis in a patient with long standing renal failure whose lesions disappeared soon after the initiation of the dialysis therapy. Some authors also have opinion that uremic stomatitis does not occur when urea concentration is maintained at a low level through dialysis (15). Hence despite the high rate of patients with renal failure only very few cases of uremic stomatitis have been reported in the literature, attributable to the advent of renal dialysis (2, 14, 15). This probably explains the absence of this finding in our study.

Very few studies have been done previously on the assessment of radiographic changes in the jawbones of ESRD patients and the data is limited. In the present study the radiographic changes were present in ten (25%) of 40 patients. Lamina dura was thinned and lost in 8 patients (22.2%) (Figure 3). Loss of lamina dura as a manifestation of subperiosteal bone resorption resulting from either primary or secondary hyperparathyroidism is well known (16) with some authors considering it to be

a first detectable sign (17) and others as a late finding in renal osteodystrophy (18).

Trabeculae of the jaws were thin and sparse in 2 patients (5.5%). Altered trabecular patterns have been pointed out in many case reports and studies on ESRD patients. The trabeculations become thin,



Figure 1 - Ecchymosis on the left lateral border of the tongue

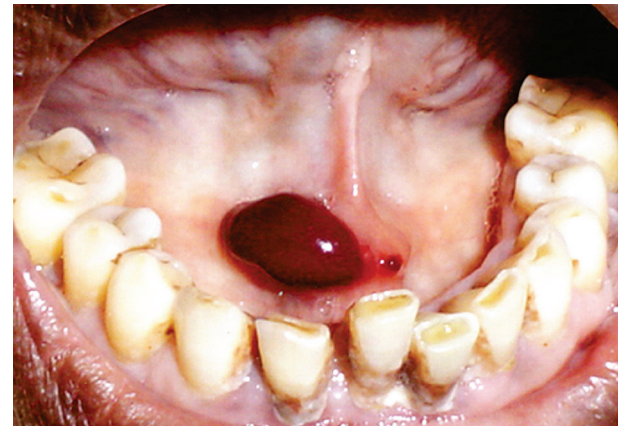


Figure 2 - Hematoma following minor tooth brush injury

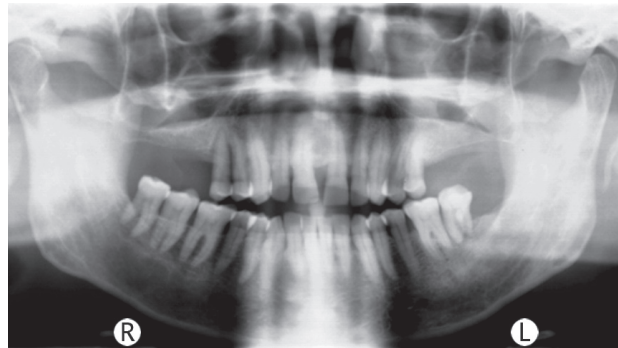


Figure 3 - Panoramic radiograph showing thinning and indistinct lamina dura surrounding most of the teeth

delicate, and closely meshed with a random orientation. Such appearances have been described by various terms such as “ground-glass”, “granular”, “chalky”, “salt and pepper”, and “peud d’orange” (orange peel) (1). Multiple, small, discrete radiolucencies were seen in the posterior mandible in 2 (5%) patients. Such osteolytic lesions due to secondary hyperparathyroidism have been described in a case report previously (19).

Calcification of pulp chambers was observed in one patient (2.7%). Though the exact cause is not known some authors suggest the role of iatrogenic hypercalcemia in the formation of calcific deposits in the dental pulp (20). Metastatic calcification of oral and paraoral soft tissues in chronic renal failure patients, though less common, have been reported (21, 22). Calcifications in facial artery, external carotid artery, stylohyoid ligament have appeared in the literature (23-25). One patient (2.5%) in the current study had bilateral stylohyoid ligament calcification (Figure 4).

Other radiographic changes mentioned in the literature (26-33) such as loss of the cortices of the mandible, mandibular canal, nasal floor or sinus walls and changes such as jaw enlargements were not observed in any of our subjects.

In the present study, it was observed that patients demonstrating radiographic changes were mostly those who were on dialysis for a relatively long duration (on maintenance hemodialysis for more than 12 months) than others (who were on hemodialysis for few weeks to few months). Ritz et al suggested that after 3 or 4 years of hemodialysis, there is a steep rise in the incidence of truly skeletal signs (34). Kelly et al. found a significant correlation between the number of months on dialysis and the absence of both lamina dura and normal

trabeculations(1). Similar observations were made by Fletcher et al. in their case report (35). In a study by Cohen et al. 29 patients undergoing routine hemodialysis for CRF were followed radiologically for the presence of osteodystrophy. In the initial period only 18% patients showed periosteal bone resorption whereas 4 years later 66% patients showed such changes (36). Similar to the previous studies and case reports we have also noticed that the frequency of radiographic changes increase with the duration on dialysis. However this cannot be substantiated as the sample size was less and patients were not followed up radiographically.

Conclusion

Some of the oral findings that were observed in this study have implications on maintenance of oral health care and also during dental treatment procedures. Xerostomia may predispose to candidiasis and increased risk of dental caries leading to periapical pathosis. If an individual has less than satisfactory oral health status, the transplantation procedure may have to be postponed. Thus early recognition of the oral manifestations is very essential. Observations such as petechiae, ecchymoses and hematoma suggest the possibilities of increased bleeding tendencies among these patients requiring additional care while performing oral surgical procedures. Findings such as uremic stomatitis are now rarely encountered with frequent use of dialysis, which decreases the concentration of uremic toxins. However dialysis fails to perform the endocrine and metabolic function of the kidneys and hence the osseous changes due to renal failure may continue to progress.

Limitations of the study

This study comprised of a small sample of patients. Among them a majority received hemodialysis for less than a year. This could be one of the reasons for us to encounter a lesser incidence of radiographic changes. However the radiographic findings were observed mostly in those who were on hemodialysis for a relatively long time. Hence we suggest further studies to be conducted on large samples with long term follow up to establish a

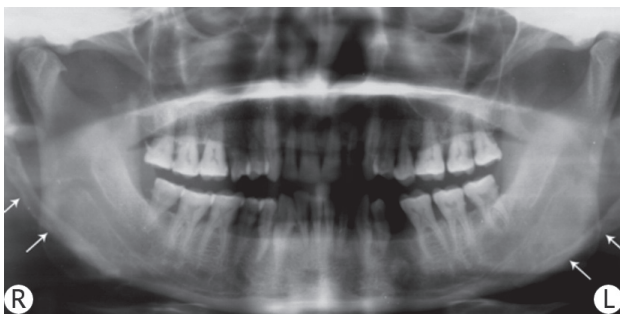


Figure 4 - Panoramic radiograph showing bilateral stylohyoid ligament calcification

definitive relation of oral and radiographic manifestations in ESRD patients with the duration of dialysis.

References

1. 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(4):372-81.
2. Antoniadis DZ, Markopoulos AK, Andreadis D, Balaskas I, Patrikalou E, Grekas D. Ulcerative uremic stomatitis associated with untreated chronic renal failure: report of a case and review of the literature. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod.* 2006;101(5):608-13.
3. Chuang SF, Sung JM, Kuo SC, Huang JJ, Lee SY. Oral and dental manifestations in diabetic and non diabetic uremic patients receiving hemodialysis. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod.* 2005;99(6):689-95.
4. Eigner TL, Jastak JT, Bennett WM. Achieving oral health in patients with renal failure and renal transplants. *J Am Dent Assoc.* 1986;113(4):612-6.
5. Proctor R, Kumar N, Stein A, Moles D, Porter S. Oral and dental aspects of chronic renal failure. *J Dent Res.* 2005;84(3):199-208.
6. De Rossi SS, Glick M. Dental considerations for the patient with renal disease receiving hemodialysis. *J Am Dent Assoc.* 1996;127(2):211-9.
7. Skorecki K, Green J, Brenner BM. Chronic renal failure. In: Kasper DL, Fauci AS, Longo DL, Braunwald E, Hauser SL, Jameson JL, editors. *Harrison's principles of internal medicine.* 16th ed. New York: McGraw-Hill Medical Publishing Division; 2005. p. 1653-63.
8. DeRossi SS, Cohen SG. Renal disease. In: Greenberg MS, Glick M, editors. *Burket's oral medicine diagnosis and treatment.* 10th ed. Canada: BC Decker Inc, Elsevier; 2003. p. 407-28.
9. Mealy B. Diabetes mellitus. In: Greenberg MS, Glick M, editors. *Burket's oral medicine diagnosis and treatment.* 10th ed. Canada: BC Decker Inc, Elsevier; 2003. p. 570-71.
10. Winkler S, Garg AK, Mekayarajananonth T, Bakaeen LG, Khan E. Depressed taste and smell in geriatric patients. *J Am Dent Assoc.* 1999;130(12):1759-65.
11. Kho HS, Lee SW, Chung SC, Kim YK. Oral manifestations and salivary flow rate, pH and buffer capacity in patients with end-stage renal disease undergoing hemodialysis. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod.* 1999;88(3):316-9.
12. Malhotra KK. Chronic renal failure. In: Shah SN, Anand MP, Acharya VN, Bichile SK, Karnad DR, Kamath SA, et al. editors. *API Text Book of Medicine.* 7th ed. Mumbai: The Association of Physicians of India; 2003. p. 695-9.
13. Galil D, Kaufman E, Leviner E, Lowental U. The attitude of chronic hemodialysis patients toward dental treatment. *Oral Surg Oral Med Oral Pathol.* 1983;56(6):602-4.
14. McCreary CE, Flint SR, McCartan BE, Shields JA, Mabruk M, Toner ME. Uremic stomatitis mimicking oral hairy leukoplakia. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod.* 1997;83(3):350-3.
15. Jaspers MT. Unusual oral lesions in a uremic patient. *Oral Surg Oral Med Oral Pathol.* 1975;39(6):934-44.
16. Hayes CW, Conway WF. Hyperparathyroidism. *Radiol Clin North Am.* 1991;29(1):85-96.
17. Kaffee I, Tamse A, Schwartz Y, Buchner A, Littner MM. Changes in the lamina dura as a manifestation of systemic diseases: report of a case and review of the literature. *J Endodon.* 1982;8(10):467-70.
18. 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(6):647-50.
19. Loushine RJ, Weller RN, Kimbrough WF, Liewehr FR. Secondary hyperparathyroidism: a case report. *J Endodon.* 2003;29(4):272-4.
20. Clark DB, Vancouver BC. Dental findings in patients with chronic renal failure. An Overview. *J Can Dent Assoc.* 1987;53(10):781-5.
21. Shear M, Copelyn M. Metastatic calcification of the oral mucosa in renal hyperparathyroidism. *Br J Oral Surg.* 1966;4(2):81-7.

22. Alawi F, Freedman PD. Metastatic calcification of the nasal septum presenting as an intraoral mass: a case report with a review of the literature. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod.* 2001;91(6):693-9.
23. Miles DA, Craig RM. The calcified facial artery. A report of the panoramic radiographic incidence and appearance. *Oral Surg Oral Med Oral Pathol.* 1983;55(2):214-9.
24. Suarez-Cunqueiro MM, Duker J, Liebehenschel N, Schon R, Schmelzeisen R. Calcification of the branches of the external carotid artery detected by panoramic radiography: a case report. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod.* 2002;94(5):636-40.
25. Sisman Y, Gokce C, Sipahioglu M. Bilateral elongated styloid process in an end stage renal disease patient with peritoneal dialysis: Is there any role for ectopic calcification? *Eur J Dent.* 2009;3(2):155-7.
26. Antonelli JR, Hottel TL. Oral manifestations of renal osteodystrophy: case report and review of the literature. *Spec Care Dentist.* 2003;23(1):28-34.
27. Andreades D, Belazi M, Antoniadis D. Diagnosis of a maxillary brown tumor associated with hyperparathyroidism secondary to chronic renal failure – a case report. *Oral Health Prev Dent.* 2004;2(2):143-7.
28. Damm DD, Neville BW, McKenna S, Jones AC, Freedman PD, Anderson WR, et al. Macrognathia of renal osteodystrophy in dialysis patients. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod.* 1997;83(4):489-95.
29. Kalyvas D, Tosios KI, Leventis MD, Tsiklakis K, Angelopoulos AP. Localized jaw enlargement in renal osteodystrophy: report of a case and review of the literature. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod.* 2004;97(1):68-74.
30. Michiwaki Y, Michi K, Yamaguchi A. Marked enlargement of the jaws in secondary hyperparathyroidism – a case report. *Int J Oral Maxillofac Surg.* 1996;25(1):54-6.
31. Hata T, Irei I, Tanaka K, Nagatsuka H, Hosoda M. Macrognathia secondary to dialysis-related renal osteodystrophy treated successfully by parathyroidectomy. *Int J Oral Maxillofac Surg.* 2006;35(4):378-82.
32. Soderholm G, Lysell L, Svensson A. Changes in the jaws in chronic renal insufficiency and haemodialysis: report of a case. *J Clin Periodontol.* 1974;1(1):36-42.
33. Weiss RR, Schoeneman MJ, Primack W, Rozycki D, Bennett B, Greifer I. Maxillary brown tumor of secondary hyperparathyroidism in a hemodialysis patient. *J Am Med Assoc.* 1980;243(19):1929-30.
34. Ritz E, Krempien B, Mehls O, Malluche H, Strobel Z, Zimmermann H. Skeletal complications of renal insufficiency and maintenance haemodialysis. *Nephron.* 1973;10(2):195-207.
35. Fletcher PD, Scopp IW, Hersh RA. Oral manifestations of secondary hyperparathyroidism related to long-term hemodialysis therapy. *Oral Surg Oral Med Oral Pathol.* 1977;43(2):218-26.
36. Cohen MEL, Cohen GF, Ahad V, Kaye M. Renal osteodystrophy in patients on chronic haemodialysis. A radiological study. *Clin Radiol.* 1970;21(2):124-34.

Received: 07/17/2011
Recebido: 17/07/2011

Approved: 08/19/2011
Aprovado: 19/08/2011