Chapter 2

Intraoral and Radiographic Findings of Chronic Renal Failure

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Abstract

Renal failure is the reduced filtering function of the kidney as a result of damage to the function of many nephrons. Depending on the decrease in kidney functions, substances such as urea and creatine accumulate in the serum, thus the fluid-electrolyte balance in the body is disturbed. Kidney diseases give many radiographic and oral findings in the jaws, early diagnosis of these findings is very valuable in terms of patient health. Knowing that oral findings are distinctive in kidney patients, healthy oral environment should be created by eliminating the foci of infection that may be serious in the future by detecting the oral health condition early. In this manner, it is extremely important to evaluate the effects of chronic renal failure, to examine the oral and radiographic findings, to determine the treatment needs and to refer these patients to the necessary treatment immediately.

INTRODUCTION

The kidneys filter the blood, help to remove harmful substances (urea, uric acid, creatinine, toxins, drugs, etc.) from the body, while maintaining the body's water and salt balance [1]. They also have many tasks such as vitamin D secretion, which increases the reabsorption of calcium and phosphorus, erythropoietin secretion, which increases the production of red blood cells, renin secretion, which plays a role in blood pressure control and also controlling the acid-base balance of the body [2].

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The smallest structural unit of the kidney is the nephron and renal failure is a condition which the filtering function of the kidney is reduced as a result of many nephronal damage. Glomerular filtration rate (GFR) indicates the total amount of blood filtered from the glomeruli per unit time. Depending on the decrease in GFR, substances such as urea and creatine accumulate in the serum, thus the fluid-electrolyte balance in the kidney is disturbed [3]. When the GFR falls below 25, signs of chronic renal failure (CRF) occur. The findings may appear with a decrease in renal function and progress to mild, moderate and severe renal failure, respectively, renal failure may occur in the end-stage, which kidney functions are severely affected and transplantation is required [4].

Oral findings that may occur in CRF patients may become more severe and lead to further problems in patients who do not have adequate oral hygiene and do not visit the dentist regularly [5]. Therefore, it is extremely important to investigate the effects of CRF on oral health, to determine the treatment needs by evaluating oral and radiographic findings and to apply the necessary treatments urgently [6].

The aim of this review is to evaluate the causes and consequences of clinical and radiographic oral findings in patients with CRF, and to increase the awareness of patients and dentists on this issue.

ORAL FINDINGS OF CHRONIC RENAL FAILURE

As CRF has many systemic symptoms, it also gives many findings in the oral region. Knowing that oral findings are distinctive, it is extremely important to create a healthier oral environment by eliminating the foci of infection that may cause problems in the long term by evaluating the oral health status in the early period.

Periodontal problems (increase in the amount of plaque, bleeding on probing, gingival inflammation, gingival recession, tooth mobility, periodontal abscess and pockets, etc.), dental caries, enamel hypoplasia, xerostomia (dry mouth), taste disturbances, mucosal lesions, gingival enlargement and calculus formation are among the main oral findings frequently seen in CRF and related treatments [4,7].

Periodontal Diseases in CRF

Periodontal disease is an inflammatory condition that affects the tissues surrounding the tooth, resulting in pocket formation, loss of attachment, gingival recession and gingival bleeding. Inadequate and ineffective removal of dental plaque lead to serious periodontal problems, while the condition of

the host has great importance in terms of the degree of periodontal disease progression [8].

It has been observed that CRF patients face serious periodontal problems due to inadequate oral hygiene. The negative effects of CRF on periodontal tissues by modifying the host inflammatory and immune response, the altered biofilm, decrease in leukocyte function in patients receiving dialysis treatment and also the neglect of oral health of these patients due to their existing systemic diseases are factors that predispose to periodontal disease. Particularly, periodontal abscesses, which may constitute a potential focus of infection, are very common in these patients [9,10].

Bodur et al. evaluated the periodontal health status of CRF patients undergoing dialysis treatment and it was observed that all of the patients diagnosed with 27 chronic periodontitis and 18 gingivitis were periodontal unhealthy. Researchers have stated that increased C-reaktif protein (CRP) level may be a cause of inflammatory exacerbation. In these patients, the immune response against bacterial plaque decreased, but there was no significant difference between plaque index and gingival index values in the study and control groups. The reason for this is explained that even if the immune response is reduced, there is still a response to bacterial inflammation. The authors reported that the major cause of periodontal disease is microbial dental plaque and periodontal health worsening as dialysis treatment course increases [10].

Davidovich et al. examined the oral health status of patients with CRF and determined that bleeding on probing and the gingival index were at a higher rate in patients with CRF compared to the healthy control group, there also a statistically significant difference was obtained. Researchers have associated these results with prolonged dialysis time. In addition, unlike other studies, gingival recession and loss of attachment were also evaluated and a higher rate was found in CRF patients. Researchers have explained the progression of periodontal disease by the patient's uremic status, duration of renal disease and poor oral hygiene [11].

Aydın et al. evaluated the oral findings related to CRF and they observed a significant increase in tooth mobility and tooth loss in CRF patients, along with an increase in periodontal problems (plaque index, gingival index, gingival recession, loss of attachment) [12].

In a study by Lütfioğlu et al., which the salivary dynamics and oral health status of pediatric patients with CRF were examined, plaque index and gingival index were found to be higher in the study group and they attributed

this to the thought that patients neglect their oral health as a result of their poor systemic health [13].

Dental Caries

Dental caries is the destruction of the tooth structure by bacteria as a result of the deterioration of the remineralization-demineralization balance in favor of demineralization in the oral cavity. The incidence of dental caries increases due to the deterioration of neglected oral health, decreased salivary flow, hypoplasic tooth surfaces, poor oral hygiene and weakened immune system in CRF patients, however the increase in pH above the critical demineralization value as a result of the increase in the amount of urea in the saliva in CRF patients also increases the buffering ability of the saliva and provides an anticariogenic effect. Accordingly, it is known that S.mutans and Lactobacillus levels decrease and the incidence of dental caries decreases. [8,14,15].

In the study of Barlak et al., which the oral and dental health status of CRF patients were examined, it was found that the prevalence of dental caries was lower in CRF patients and no caries was observed in 16 of the 55 patients examined [6].

Ertuğrul et al. evaluated the oral findings of terminal stage CRF patients and high salivary buffering capacity was found in 89.5% of the study group. Lower levels of S.mutans and Lactobacillus were detected in the study group and it has been reported that this may be due to increased levels of antibacterial agents [15].

Obry et al. examined the biochemistry of saliva in CRF patients, the DMFT index was found to be zero in 56% of the patients [16].

Al nowaiser et al. examined the oral findings of 70 healthy children and 70 children with CRF, no dental caries was detected in 40% of the patients. Researchers have associated this with high urea concentration, high salivary buffering capacity and low amount of S. mutans [8].

In the study of Thorman et al., unlike other studies, the DMFT index was found to be higher in adult patients at different stages of CRF. The authors attributed these results to the uremic status of adult patients, poor oral hygiene and concomitant medical endangerment with systemic disease [14].

Enamel Hypoplasia

Enamel hypoplasia is known as defective calcification areas that cause permanent marks on the surfaces of maturing teeth as a result of disruption

of enamel matrix secretion and may cause some problems such as increased sensitivity of the teeth, weakening of dental hard tissues due to decreased mineral content and deterioration of aesthetic appearance [17,18].

The major causative factor of enamel hypoplasia in CRF patients is hypocalcemia. In addition, increase in phosphate and parathormone and decrease in 1,25 dihydrocholecalciferol in serum can be counted among the factors that cause enamel hypoplasia. In CRF patients, dental enamel defects can be seen in many forms such as pits, grooves, transparent, diffuse nebula, etc. [18,19].

Aktören et al. evaluated oral symptoms in children diagnosed with CRF before and after the age of 6, enamel hypoplasia was observed in 20 of 23 children with CRF before the age of 6 years. This rate was found to be lower in children with CRF after 6 years of age. Researchers have associated this condition with renal failure coinciding with the developmental period of the teeth [20].

Nunn et al. examined the oral findings of 38 patients who applied to a local kidney diseases center, 20 of whom had a previous kidney transplant, 11 of whom had CRF and 7 of whom had other kidney diseases, the rate of enamel opacities (diffuse nebula areas, diffuse opacities, transparencies) was 83% and the rate of enamel hypoplasia (grooves, pits, large missing layers) categorized separately was 22%. Researchers have reported that this may be due to impaired calcium-phosphate metabolism [18].

Ertuğrul et al. evaluated oral findings in children with end-stage renal disease, enamel hypoplasia was found in 47.7% of the patients and researchers have reported that this may be associated with abnormal calcium-phosphate metabolism [l5].

Barlak et al. examined the oral and dental health status of 55 patients with CRF and reported that 28 of the patients had varying degrees of enamel hypoplasia in the existing teeth [6].

Davidovich et al. stated that the severity of hypoplasia in CRF patients may be related to age and the time elapsed since the onset of the disease, they also drew attention to the possible correlation between the location of hypoplasia on the tooth and the age of onset of renal failure [11].

Dry mouth (Xerostomia)

The state of being dehydrated as a result of the decrease in the amount and quality of the salivary fluid is defined as xerostomia. Factors such as uremic involvement of salivary glands, decreased saliva amount, medications

and decreased fluid intake may cause dry mouth in patients with CRF. Additionaly, dry mouth brings with many problems such as an increase in caries, periodontal diseases and tooth loss [4,21].

Nascimento et al. examined oral symptoms in CRF patients and they noted that xerostomia was observed in 44.6% of the patients. Researchers have associated this situation with decreased kidney capacity and reduced fluid intake and they have suggested that drugs used in the treatment of kidney failure may also cause dry mouth. [9].

Lütfioğlu et al. examined the salivary content of CRF patients undergoing dialysis treatment and reported that the cause of dry mouth is not only the decrease in saliva, but also the increase in protein concentration in the salivary content [13].

Taste Disturbances

Impairment of taste sensation is called dysgeusia and different tastes such as metallic, bitter or abnormal tastes in the mouth may be encountered in patients with CRF. The taste disturbances in these patients are thought to be due to urea concentration in the mouth, medications and salivary composition [9,22].

Nascimento et al. evaluated oral symptoms in CRF patients, taste disturbances were found 31.1% of the patients. Researchers have reported that dysgeusia may be associated with high concentrations of urea in saliva. In addition, it was stated that there was a significant relationship between the amount of drug used and dysgeusia [9].

Mucosal lesions

Petechiae, ecchymosis and hemorrhage can be seen in the intraoral mucosa due to aggregation disorders in platelets and heparin used in dialysis treatment in CRF patients. Oral mucosa is pale due to decreased erythropoietin secretion in CRF patients. Mucositis or glossitis may also occur due to low salivary secretion in CRF patients [4].

Gingival Enlargement

Gingival enlargement is increasing volume in the gingiva that develops due to many reasons such as hormonal changes, mouth breathing, ill-fitted dental prostheses, inadequate oral hygiene, systemic diseases and medications. Gingival enlargement in CRF patients may be due to poor oral hygiene and the drugs used (antihypertensive, immunosuppressive, anticonvulsant) [11].

Al nowaiser et al. examined the oral findings of 70 healthy children and 70 children with CRF, a significant difference was found in CRF patients compared to the control group in terms of gingival enlargement. In the study group, 11% gingival enlargement was detected and these patients were found to be used nifedipine continuously or intermittently during the study [8].

Davidovich et al. found a positive relationship between gingival enlargement and use of nifedipine in their study which examining periodontal findings in children and adolescents with CRF [11].

Barlak et al. examined the oral and dental health status of patients with CRF, no statistically significant difference was found between the study and control groups in terms of gingival enlargement [6].

Nunn et al. examined the oral health status of 38 pediatric patients with CRF, mild gingival hyperplasia was found in children, but no significant relationship was found between gingival enlargement and the use of nifedipine or cyclosporine. It has been reported that this situation is perceived as a result of irregularity in the gingival contours, since it is a transitional period between primary and permanent dentition [18].

Calculus Formation

Calculus is a mineralized structure with organic and inorganic content formed as a result of the precipitation of calcium and phosphate salts on the bacterial plaque which adhering to the surface of the teeth and existing dentures in the mouth. Decrease in magnesium level, increase in urea and phosphorus levels and precipitation of calcium and phosphate cause calcium oxalate formation in CRF patients. This accumulation causes calculus formation and the reduced amount of saliva also contributes to this accumulation [9].

Nascimento et al. evaluated oral symptoms in CRF patients, calculus was detected 52.7% of the patients. It has been suggested that patients with a low biofilm index may have a high amount of calculus and additionally it has been reported that lack of oral hygiene and reduced amount of saliva can cause calculus accumulation [9].

RADIOGRAPHICAL FINDINGS

Changes in bone metabolism and dental hard tissues can be seen on dental radiography are common in CRF patients and it is known that these changes are due to secondary hyperparathyroidism, which shows low calcitriol and high phosphorus levels. These changes can occur simultaneously

and cause resorption of the jaw bones [23,24]. Loss of the lamina dura and changes in the jaw bones (decreased bone density, decreased trabeculation, osteosclerosis, alveolar bone loss, soft tissue calcifications, thinning of cortical layers) are the most common radiographical findings [25].

Loss of Lamina Dura

In dental radiography, the radiopaque, thin layer of bone surrounding the tooth socket is called the lamina dura. While various systemic diseases cause loss of the lamina dura, loss of the lamina dura due to bone resorption under the periosteum as a result of hyperparathyroidism is a common condition in CRF patients [2,26].

Özel et al. compared the oral findings of CRF patients and healthy individuals, loss of lamina dura was evaluated using panoramic radiographs of 149 CRF patients and 200 healthy individuals. Lamina dura loss was found to be two times higher in the study group. However, it was pointed out that the invisible buccolingual surface of the teeth and the distortion in the two dimensional radiographic images can be misleading when detecting loss of lamina dura on panoramic radiographs [2].

Çağlayan et al. evaluated changes in teeth and jaw bones in CRF patients with using dental tomography and reported that the mandibula was more porous, also soft tissue calcifications, loss of lamina dura and radiolucent lesions were more common in CRF patients [27].

Kelly et al. examined changes in the jaw bones of CRF patients, 53% of patients had changes in the lamina dura and 45% of the patients had partial loss of the lamina dura, while only 8% had complete or near-complete loss of the lamina dura. [28]

Rai et al. evaluated the radiographical changes in the jaw bones of CRF patients, lamina dura loss was found to be higher in the study group and a statistically significant results were obtained [29].

Changes in the Jaw Bones

Since phosphate excretion is not adequately achieved in CRF patients, serum phosphate level increases, however vitamin D synthesis decreases and serum calcium level decreases. A low calcium level increases the secretion of parathormone and calcium transfer occurs from the bone to the blood. In this case, secondary hyperparathyroidism develops and a condition called renal osteodystrophy occurs. The findings of renal osteodystrophy in the jaw bones are varying; often a decrease in bone density is observed, but

sometimes an increase in bone density (Brown tumor) can also be observed. Changes in the number of bony trabeculae, enlargement of the maxilla, metastatic soft tissue calcifications or changes in the jaw bones giving a ground-glass-like radiographic appearance may be observed [30,31]. Another change that is thought to be caused by abnormal bone metabolism in hyperparathyroidism is Brown tumors, which are described giant cell-rich lesions and can cause symptoms in the jaw bones (32).

Coşgunarslan et al. evaluated the quality of mandibular bone in CRF patients through fractal analysis on panoramic radiographs and found that CRF and renal osteodystrophy adversely affected bone in terms of mineralization and volume, bone fragility increased and this situations significantly affect the clinical success of dental treatments (tooth extraction, implant, orthodontic treatment) [25].

Özel et al., examined oral and radiographic findings in 149 CRF patients, Brown tumor was observed in only 1 (0.7%) person in the study group, while Brown tumor was not found in the control group of 200 people [2].

Shaikabei et al. evaluated the radiographic changes in the jaw bones and teeth of 74 CRF patients that undergoing hemodialysis treatment. Thinning or loss of the lamina dura in 16 patients, changes in trabecular bone in 30 patients, changes in jaw bone density in 29 patients, and bilateral calcification in the stylohyoid ligaments in 13 patients were observed. It is not known whether these changes are related to the duration and frequency of dialysis [33].

Conclusion

It should not be forgotten that CRF patients need professional support in terms of oral and dental health, considering their systemic condition. Intraoral and radiographical changes should be evaluated on reguşar follow-ups, especially periodontal treatments should be performed at regular intervals. Since every CRF patient is a potential transplant patient, necessary dental treatments should be done as soon as possible. Especially in transplantation patients, all treatments should be done before the transplant procedure, because the patients will be in a state of immunosuppression after the transplantation and their body resistance against infection will decrease. For this reason, it has been recommended that dental treatments should be performed with a more radical approach in CRF patients in case of transplantation and that teeth with a poor prognosis which may cause problems in the future should be extracted.

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