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Research Article

Radiographic Study of Lamina Dura in Patients on Corticosteroids

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Abstract

Introduction: Lamia dura is one of the important components in the "periodontium" that encircle the socket of the tooth because it provides the connection area to the periodontal ligaments (Sharpey's fibers). In addition, the lamina dura has a significant role in the remodeling of the bone, so in this way in orthodontic therapy. The presence of intact and regular lamina dura often refers to a "healthy periodontium". Many conditions may affect the status of lamina dura, which may lead to disruption in the symmetry and uniformity of the lamina dura.

Purpose of the Study: To observe the possible "radiographic changes" of lamina dura in patients treated with "corticosteroids".

Materials and Methods: The study included fifty-two individuals aged between 18 - 45 years who referred to the oral radiology units in some dental specialized centers of Baghdad capital from December 2018 to December 2019 for taking periapical radiographs. Thirty-two of individuals were healthy and without any systemic diseases and they are considered as a control group and the other twenty individuals were with a history of treatment with different doses of "oral or systemic corticosteroids" for at least two years ago and up to five years maximum and they are considered as patient group. A total of 1439 "periapical radiographs" selected in the study for evaluating the thickness of lamina dura including the anterior and posterior teeth in upper and lower jaws and excluding third molars for two groups. All "periapical images" were viewed on the monitor using digital radiography. Different patterns of examining lamina dura from the two groups had shown in "periapical radiographic images".

Results: From the total of the two groups, the results in the patients treated with "corticosteroids" showed that the pattern IV of lamina dura was more than the other patterns in the percentage of 21.61%, followed by pattern V (13.96%), the pattern I (8.33%), pattern II (4.37%), pattern III (3.26%) respectively. In addition, the results showed that the pattern I of lamina dura was more in the control group in percentage of 35.71%, followed by pattern V (4.51%), pattern III (3.68%), pattern II (2.64%) and pattern IV (1.87%), respectively. The statistical analysis showed that there was no significant relationship regarding the lamina dura changes between the patients' group and healthy group of p-value < 0.05 (Spearman' Rho, rs = 0.2, p-value = 0.7).

Conclusion: The study found that the use of "corticosteroids" has no direct effect on the status of lamina dura.

Keywords: *Radiography; Lamina Dura; Patient; Corticosteroid*

Introduction

The lamina dura is a narrow thin layer of dense cortical jaw-bone so-called "alveolar bone proper" or cribriform plate. It surrounds roots of sound teeth and continuous with the shadow of the cortical plate till the alveolar crest. Radio-graphically, the lamina dura seen as a thin radiopaque line bound the normal tooth socket. The side adjacent to the roots is the periodontal membrane which is seen as a thin radiolucent shadow on the radiograph. The opposite side and below the lamina dura is the cancellous bone [1,2].

Clinically, differentiation of a lamina dura is most likely impossible due to small differences and perturbations in the uniformity of the lamina dura that may result from overlies of cancellous bone and delicate nourishing canals crossing through the lamina dura from cancellous bone spaces to the periodontal space [1].

Factors affecting the radiographic appearance of lamina dura

Any changes in the x-ray beam "angulation" may affect the appearance or disappearance of lamina dura and periodontal membrane space on radiographs [3]. When the x-ray beam passing lamina dura thickness cause attenuation and seen as radiopaque. This radiopaque appearance of lamina dura is well defined and narrow in the case of x-ray passing directly through a relatively wide area of lamina dura and in the case of the mesial and distal sides of the root is flat. On another side, the radiopaque appearance is diffused in the case of the x-ray passing obliquely through lamina dura and in the case of the mesial and distal sides of the root is not flat because the amount of penetrating radiation is small. In addition, The density and thickness of lamina dura also vary relative to the occlusion stresses exerted on the teeth, so radio-graphically, the lamina

dura is seen denser and wider around the tooth root subjected to heavy forces or occlusion [2].

Other factors may affect the thickness of lamina dura and its clarity like the concavity or convexity of the mesial and distal tooth surfaces, CEJ level, root curvature, and alveolar bone thickness [3]. Many problems in the visualization of lamina dura and periodontal ligament can be resolved by using recent imaging technologies. The computed tomography is introduced to get a three-dimensional evaluation of head and jaws. The maxillofacial diagnosis has become easier by CT [4,5]. Nowadays, cone-beam computed tomography (summarized as CBCT) is the most advanced developed technology for imaging, which considerably improves diagnosis in the maxillofacial region and thus the pathologies [6]. The quality of imaging in CBCT was proved to be better than that of CT in the evaluation of the periodontal space and lamina dura [7].

The adverse effects of "corticosteroids"

Steroids are considered one of the oldest types of the drug for several decades since the 1950s [8]. They have been used wildly in treating various diseases for decades [9].

Despite the improvement of symptoms for many patients who are treated with steroids, long-term treatment with steroids lead to serious side effects, such as suppressing the body's immunity to becoming more susceptible to infection, and impairment of wound healing, cardiovascular diseases, weight gain, metabolic changes in lipid and glucose, weakened bones (osteoporosis stretch marks), psychosis and other psychiatric symptoms [9,10].

"Corticosteroids" are associated with adverse effects on the function and life of "osteoblasts" in addition to "osteocytes", as well as causing the extension of "osteoclast" life and encourage the metabolic disease of bone. In a healthy individual, there exists a fixed equilibrium of activity between "osteoblasts" (bone-forming cells) and "osteoclasts" (bone destructing cells) and any disturbance in this balance may result in bone loss and weakening the bone mass at the early stages causing "osteopenia" and then "osteoporosis" at the later stages due to over-activity of "osteoclast" [11].

Another metabolic bone disease like "osteonecrosis" may also result due to long term steroids, which may occur in about 9-40% of those patients and this may occur regardless of steroid-induced osteoporosis [12,13].

The bone disease caused by "glucocorticoid" basically affects cancellous bone result in an increased risk of rib and vertebral fractures [14]. Others stated that the most bone liable to fracture due to oral "corticosteroid cycles" was humerus [15]. The catabolic effect of the vitamin D and the muscle is also associated with steroid treatment which leads to decreased mineralization of bone [16,17]. Furthermore, long term steroid treatment, causes obesity and adipocytes synthesis with inhibition of vitamin D [18,19].

In addition to the direct effects, there are indirect adverse effects of "corticosteroids" such as reduced intestinal absorption of calcium, increased urinary expulsion of calcium, decrease growth hormone secretion and alterations in stimulating of parathyroid hormone and alterations in the steroid sex metabolism [14]. The studies reported that "osteogenic tissues" considered the main target for these drugs and act directly on bone cells, so this consider the important mechanism in the development of osteoporosis [14,20].

Many studies stated that using "oral corticosteroid" for a long period causes a significant reduction of calcium absorption and thereby elevates the rates of bone reduction and fracture [21-24].

Action mechanism of "corticosteroids"

Bone reduction happens shortly after the treatment with "corticosteroids" is started and this comes from a complicated process including the inhibition of "osteoblast synthesis" and elevates the resorption of bone [25].

"Corticosteroids" inhibit the synthesis of "osteoblast", raise the "osteoblast" death and suppress their efficiency for osteogenesis. "Corticosteroids" decrease the synthesis of "osteoblast" and increase "osteoblast" death and in turn, result in a reduction of bone formation [26,27].

It has been shown that administering "glucocorticoids" result in converting the osteogenic potential of bone marrow stem cells into lipid differentiation leads to a decrease in "osteoblast" synthesis [28,29]. The high rates of producing reactive oxygen types caused by steroids lead to programmed cell death of the "osteoblast" [30]. In addition, steroids cause a reduction of "cytokines", which derived from "osteoblasts" as interleukin 11 which reduces the differentiation of "osteoblast" [31].

"Corticosteroids" also reduce "osteoclast" synthesis [27,31,32]. This may be mediated via the receptors of "glucocorticoid" found in both osteoblasts and osteoclasts [31,32]. But on the other side, steroids do not cause "osteoclast" death and may increase the life span of "osteoclast". As well as steroids may also suppress the activity of "osteoclast" to cause bone resorption by intervening with their

"cytoskeleton" by the action of macrophage colony-stimulating factor [32].

Materials and Methods

The study included fifty-two individuals aged between (18 - 45) years who referred to the oral radiology unit of different dental centers in Baghdad from December 2018 to December 2019 for taking periapical radiographs, thirty-two of them were without any systemic diseases and they are considered as a control group and the other twenty individuals were found with a history of treatment with different doses of oral or systemic corticosteroids for a period of at least two years ago up to five years maximum and they are considered as patients group.

A total of 1439 periapical radiographs from the two groups (control and patient) were selected in the study for evaluating the thickness of lamina dura including the anterior and posterior teeth in upper and lower jaws. The study excluded the upper third molars for two groups (Figure 1-3).

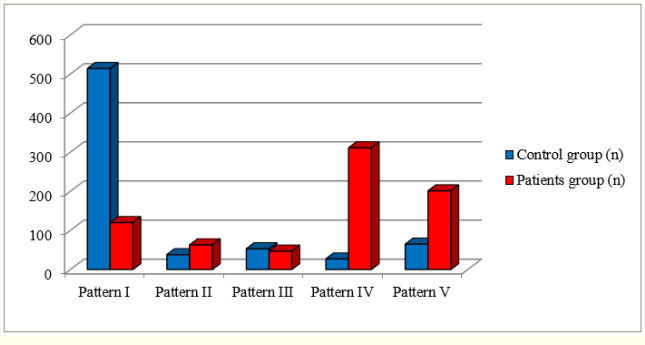

Figure 1: Distribution of radiographic lamina dura patterns in control and patients group.

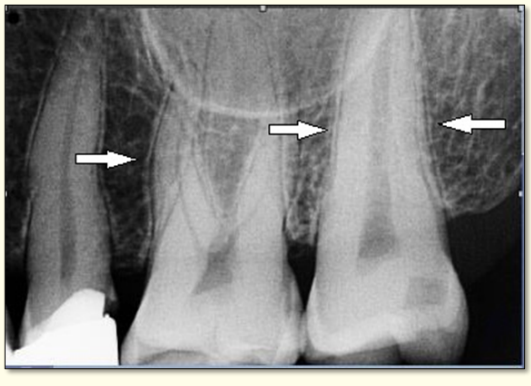

Figure 2: A periapical radiograph showing maxillary first and second molars with pattern [I]; normal thickness of lamina dura (white arrows)

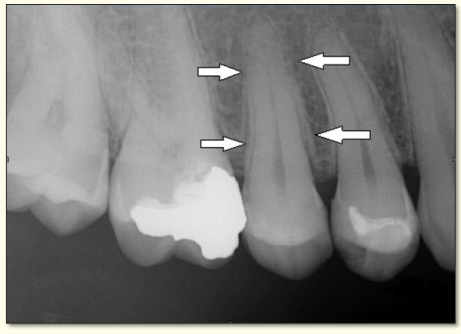

Figure 3: A periapical radiograph showing maxillary first premolars with pattern [III]; parts of thickened and thinned lamina dura (white arrows).

The thickness of lamina dura was evaluated according to the modified standards introduced by Vidyullatha., *et al* [33]. The normal range of lamina dura thickness was ranged 0.22 - 0.54 mm [34].

The study used the digital radiography and the periapical radiographs viewed on the monitor The assessment of lamina dura was carried out on theses radiographs in each selected tooth by evaluating the entire thickness of lamina dura along the tooth socket starting from the maximal point of lamina dura toward the periodontal space and to the maximal point of lamina dura toward the cancellous bone of the opposite side. After the assessment, different patterns of examining lamina dura had shown in the current study were classified from Cl I to Cl V, these patterns were inspired by the modified standards of Vidyullatha., *et al*. [33] (Table 1). All patients have explained to them the goal of the study through signed consents.

Statistical analysis

Data were analyzed using the Statistical Package for the Social Sciences software (version 19). The relation between the patient and healthy group was analyzed by Spearman's Rank Correlation Coefficient (Spearman' Rho) and the significance level adjusted 0.05 and a value of $P < 0.05$ is statistically significant.

Results

The statistical analysis of the two examined groups (healthy and patient groups) showed that the pattern IV was more in patients group treated with "corticosteroids" in the percentage of 21.61%, followed by pattern V (13.96%), the pattern I (8.33%) pattern II (4.37%), and pattern III (3.26%), respectively. In addition, the results showed that the pattern I was more in the control group in percentage of 35.71%, followed by pattern V (4.51%), pattern III

Patterns of lamina dura	Radiographic appearance
Pattern I	The entire lamina dura within the normal thickness
Pattern II	The entire lamina dura is significantly thickened
Pattern III	Parts of Lamina dura are thickened and thinned
Pattern IV	Lamina dura is significantly thinned; some areas are missing
Pattern V	Lamina dura is basically disappeared, but may appear in different areas

Table 1: Classification of "radiographic lamina dura patterns" in the current study - Inspired by the modified standards provided by Vidyullatha., *et al* [33].

Radiographic patterns of lamina dura	Control group n (%)	Patients group n (%)
Pattern I	514 (35.71%)	120 (8.33%)
Pattern II	38 (2.64%)	63 (4.37%)
Pattern III	53 (3.68%)	47 (3.26%)
Pattern IV	27 (1.87%)	311 (21.61%)
Pattern V	65 (4.51%)	201 (13.96%)
Total	697(48.43%)	742(51.56%)

Table 2: Frequency and percentage of radiographic lamina dura patterns in the jaws of both control and patients group.

(3.68%), pattern II (2.64%) and pattern IV (1.87%) respectively (Table 2). The statistical analysis showed that there was no significant relationship between the control group and patient groups at p-value < 0.05 (Spearman' Rho, rs = 0.2, p-value = 0.7).

Discussion

Many studies showed the importance of "periodontium" for a healthy dentition. Lamina dura considered one of the most important bony components of the "periodontium" that surround the tooth socket. It precipitates in the remodeling of the bone, so it plays a significant role in the orthodontic therapy.

The importance of lamina dura in diagnosis was confirmed. A uniform and intact thickness of lamina dura encircling the "periapical" area strongly ensure the vitality of the pulp [35].

Several studies confirmed that any variation in the uniformity, density, and width of lamina dura may indicate the existence of different pathologies and dental diseases [36-38]. Lee stated that the disruption of lamina dura continuity may suggest the primary indication of the lesion in the "periapical" area [39].

Yokota., *et al.* stated that the disappearance of lamina dura is identified and diagnostic feature of pathology, but this is absolutely correct when there are discontinuity and interruption of lamina dura close to the apical area [40].

In addition, others stated that the thinning of lamina dura has indicated the localized or generalized disorders, as in the case of Paget's disease or hyperparathyroidism [41,42].

The current study observed the possible "radiographic changes" of lamina dura in patients treated with "corticosteroids" compared to the control individuals. The study showed that there were different "radiographic patterns" of lamina dura had evaluated in the two groups. So, from the total of two groups, the results showed that the ratio of pattern IV (21.61%) was more in patients group treated with "corticosteroids" followed by pattern V (13.96%), pattern III (8.33%), pattern II (4.37%), the pattern I (3.26%) respectively, while in the control group, the results showed that the ratios of lamina dura patterns were pattern I (35.71%), followed by pattern V (4.51%), pattern III (3.68%), pattern II (2.64%) and pattern IV (1.87%) respectively. In comparison, between the healthy and patients group, the statistical analysis showed that there no was correlation between the occurrence of these "radiographic changes" in lamina dura and the use of "corticosteroids".

Noticeably, the proportions of lamina dura pattern IV and V in patients treated with "corticosteroids" in the current study were more than other patterns. This may be associated with "bone demineralization" which is considered one of the evident adverse effects of "corticosteroids". Because the lamina dura considered a sensitive bone and it may be affected by the negative effects of "corticosteroids", although these changes were considered not significant in the current study.

However, the changes of lamina dura in the current study may not be related exclusively to the use of steroids, but there may be other factors that may have a role in the occurrence of these changes. For example, some studies stated that there was a considerable variation in thickness and density of lamina dura between individuals and even at the same person [35,43]. This may be due to differences in the configuration of roots [35]. Others referred to that there was disarrangement of lamina dura with progressing the age

[44]. Some authors stated that bone loss in the human body was increased due to systemic variations [45]. So, the bone loss was observed in severe lung disease [46]. Shakibaei., *et al.* observed the radiographic changes of lamina dura in patients with renal diseases and they found that the ratios of partial loss in lamina dura were 25.7 percent and 45 percent of the study sample while the ratios of complete or semi-complete loss in the lamina dura in other studies were 74 percent, 25.7 percent and 8 percent of the study sample [47]. Some authors stated that the lamina dura becomes thicker with large occlusion forces and thinner around the teeth, which are not liable to occlusion forces [1].

Overall, the current study showed that the ratio of the changed lamina dura in the control group was 48.43% and in the patients' group was 51.56%.

Several studies observed the radiographic changes of lamina dura in patients with renal diseases, so some authors found that the lamina dura was changed in 51.4% of the study sample (partially lost 25.7% and totally or almost totally lost in 25.7%) [47]. Kelly found that the lamina dura was changed in 53% of the study sample (partially lost 45% and totally or almost totally lost in 8%) [48]. Rani found that the lamina dura was changed in 70% of the study sample [49]. Rivas found that the lamina dura was totally absented in 74% of the study sample [50].

On the other hand, the variable patterns of the lamina dura in the current study may not be related only to the use of "corticosteroids", but there may be other factors as environment, dosage of the drug, age of patient, gender and nature and type of food.

Conclusion

The study conducted that the use of corticosteroid has no direct effect on the status of lamina dura.

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Conflicts of Interest

There are no conflicts of interest.

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