Republic of Iraq
Ministry of Higher
Education
and Scientific Research
University of Baghdad
College of Dentistry

Lamina Dura in health and diseases

A Project Submitted to
The College of Dentistry, University of Baghdad,
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for the Bachelor of Dental Surgery

By
Sara kareem obied

Supervised by:
Assist. Prof. Zainab Hasan

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Introduction

Before talking about lamina dura it should be know the Anatomical structures and nature of tooth in general. Tooth composed of the following structures: Enamel is the hardest substance in the human body, and it covers the outer surface of your

teeth. It is made mostly of an extremely hard mineral called calcium phosphate. Dentin makes up the layer just below your tooth's enamel. It consists of living cells that secrete a mineral substance. Pulp is the soft, inner part of each tooth that contains its blood supply and nerves. Cementum is made from connective tissue that binds the roots of your teeth to your gum tissue and jaw.The periodontium is a connective tissue consisting of four components: cementum, the periodontal ligament (PDL), alveolar bone and gingival tissue.
(**Matthew Hoffman, 2020) (Nanci, 2013)**

Lamina dura:

Lamina dura is a radiographic term denoting the plate of compact bone (alveolar bone) that anatomically surrounds and supports the tooth and lies adjacent to the periodontal ligament. It is continuous with the cortical bone at the alveolar crest. Histologically, it is the compact variety of bone. It is perforated by many openings that carry branches of interalveolar nerves and blood vessels into periodontal ligament; hence, it is known as cribriform plate. It is also called as bundle bone as the bundles of fibres of periodontal ligament get embedded in it as Sharpey's fibres.**(Jstor, 2018)**

Aims of the study

The Aim of this project is to clear the importance of lamina dura and it's relation with different pathologies **(radiographicaly)**

Chapter one

Review of literature

1-Radiographic appearance of lamina dura:

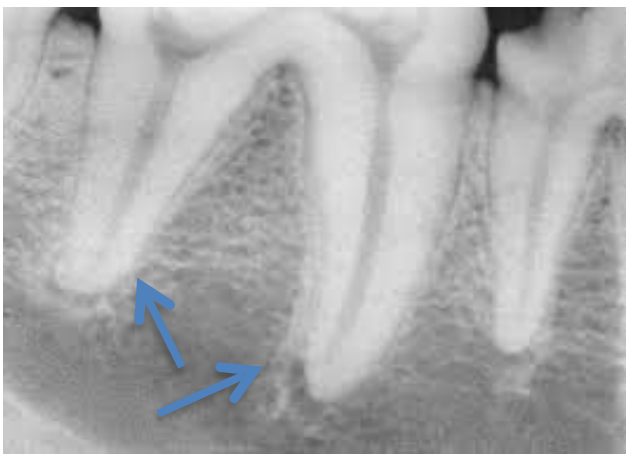
Lamina dura is compact bone that lies adjacent to the periodontal ligament, in the tooth socket. The lamina dura surrounds the tooth socket and provides the attachment surface with which the Sharpey's fibers of the periodontal ligament perforate. On an x-ray a lamina dura will appear as a radiopaque line surrounding the tooth root as seen in **Fig(1).** An intact lamina dura is seen as a sign of healthy periodontium. Lamina dura, along with the periodontal ligament, plays an important role in bone remodeling and thus in orthodontic tooth movement.

Under the lamina dura is the less bright cancellous bone .Trabeculae are the tiny spicules of bone crisscrossing the cancellous bone that make it looks spongy. These trabeculae separate the cancellous bone into tiny compartments which contain the blood producing marrow.Even if the supporting bone is healthy and intact, the identification of the lamina dura which is completely surrounding each root of the tooth is difficult or it is usually evident to some extent about the root.The thickness and the density of the lamina dura vary with the amount of occlusal stress to which the tooth is subjected .Accordingly lamina dura on the radiograph is wider and denser around roots of the tooth in heavy occlusion and thinner and less dense in one with less or not subjected to occlusal function.
(Hussein Haleem, 2020)

Fig(1):lower periapical view, Healthy lamina dura**.(Hussein Haleem, 2020)**

2-Chevron sign

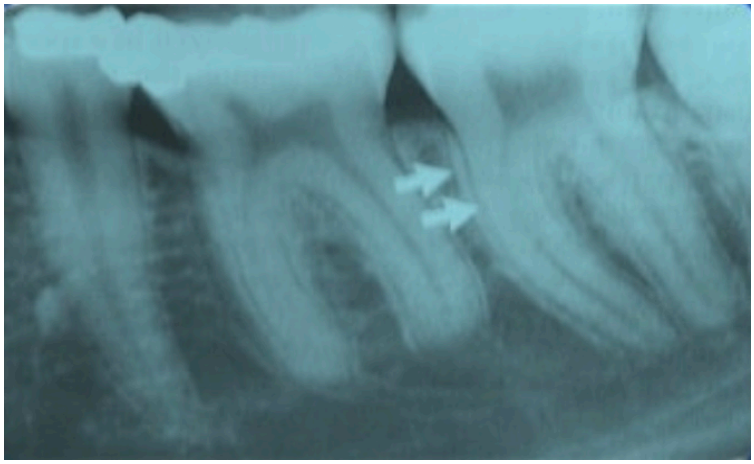
The appearance of lamina dura on radiograph may vary when the X-ray beam is directed through a relatively long expanse of the structure. However, when the beam is directed more obliquely, lamina dura appears more diffuse and may not be discernible. In addition, small variations and disruptions in the continuity of lamina dura may represent superimpositions of trabecular pattern and small nutrient canals passing from mandibular bone to periodontal ligament as seen in **Fig(2). (Santiago, 2017)**



Fig(2):lower periapical view, the chevron sign.**(Santiago,2017)**

3-Double lamina dura

The image of double lamina dura is not uncommon if the mesial or distal surface of the root presents two emenences in the path of X-ray beam.Like a mesial surface of mandibular second molar root (buccolingually), so double lamina dura is seen as in **Fig(3).(Lavanya Samraj, 2014)**



Fig(3):lower periapical view, Double lamina dura**.(Lavanya Samraj, 2014)**

4-Lamina dura in health

The presence of the lamina dura around the apex of the tooth strongly suggests the vital pulp. However, the absence of the lamina dura around the apex in radiograph may be normal.It may be absent in the molar root extending into the maxillary sinus .When the apices of the molars are projected over the canal, the lamina dura may be overexposed, giving the impression of missing lamina dura or thickened periodontal ligament space that is more radiolucent than which is apparently normal to the patient. Hence, other clinical procedure, may be employed to ensure the soundness of the tooth such as vitality test**.(Priyanka, 2015)**

5-Lamina dura in diseases

Changes in the lamina dura are associated with dental diseases around the root of the tooth and with systemic diseases.**(Molly, 2014)**

Lamina dura loss classify according to the location into:

A. Localised loss
B. Generalised loss

Table(1): Classification of localised loss of lamina dura.**(Molly, 2014)**

A. Localised		

1)Normal variations:

- **Apex of maxillary canine (canine fossa)**
- **Tooth rotation**
- **Maxillary premolars before maturation**
- **Projection over maxillary sinus**
- **Tongue out of roof of mouth during panoramic radiography**
- **Projection over mandibular canal**
- **Projection over mental foramen**

2)Pathological conditions: (Molly, 2014)

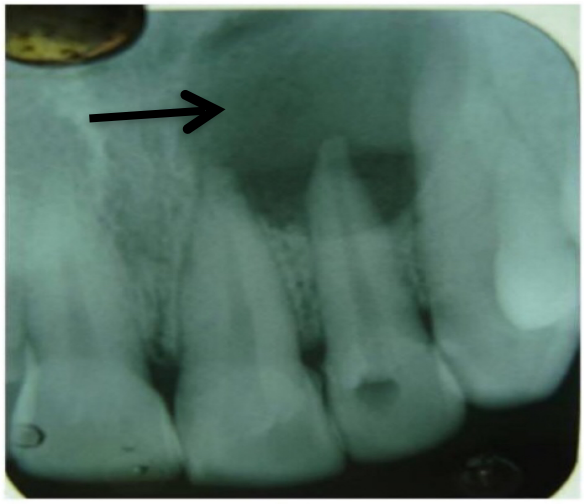
- **Periapical Inflammatory Lesion**
- **Periodontal Disease**
- **External root resorption**
- **Traumatic Injury to Teeth**
- **Malignancy**
- **Traumatic Bone Cyst**
- **Periapical Cemental Dysplasia**
- **Central Giant-cell Granuloma**
- **Fibrous Dysplasia**
- **Paget Disease**
- **Dental caries**
- **Gingivitis**
- **Sclerosing osteomyelitis**

Localised Loss of Lamina Dura:

- **Periapical Inflammatory Lesion**

In this the lesion usually starts at the apical portion of periodontal ligament space. The radiographic appearance varies depending on the time course of the lesion.

In chronic cases, the apical lamina dura is usually lost. In periapical cyst, the apical portion of lamina dura is continuous with the periphery of the cyst as seen in **Fig(4).(Gregg A, Linda J, 2009)**



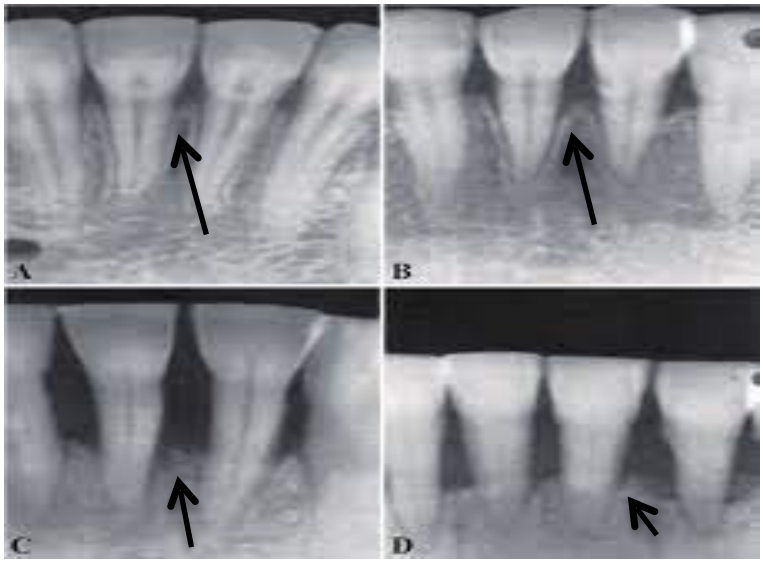
Fig(4):upper periapical view, Periapical Inflammatory Lesion**.(Gregg A, 2009)**

Radicular cyst: Commonly known as a dental cyst, the periapical cyst is the most common odontogenic cyst. It may develop rapidly from a periapical granuloma, as a consequence of untreated chronic periapical periodontitis.Periapical is defined as "the tissues surrounding the apex of the root of a tooth" and a cyst is "a pathological cavity lined by epithelium, having fluid or gaseous content that is not created by the accumulation of pus.Most frequently located in the maxillary anterior region, the cyst is caused by pulpal necrosis secondary to dental caries or trauma**.(Menditti, 2018)**

- **Periodontal Disease**

In early periodontal disease, the normally occurring sharp angle between lamina dura and alveolar crest may lose its normal cortical margin and appear rounded off, having an irregular and diffuse border.

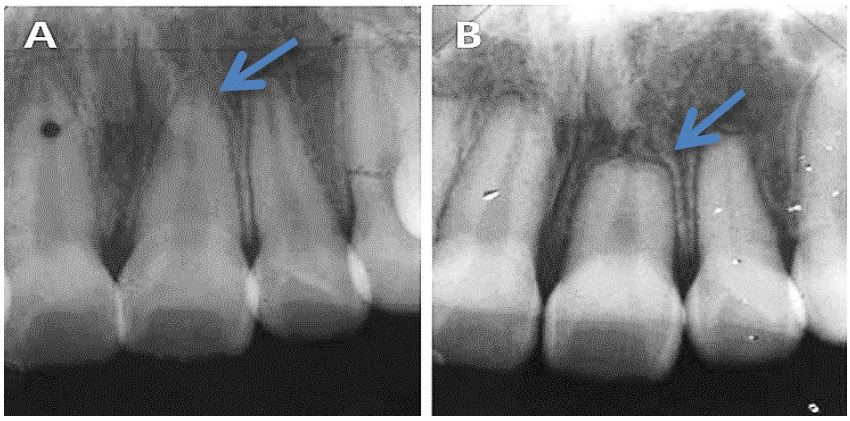
The Height of the alveolar crest lies at the level approximately 1–1.5 mm below the level of the cementoenamel (CE) junction of the adjacent teeth. Between the anterior teeth, the alveolar ridge is usually pointed and has a dense cortex. Between posterior teeth, the alveolar crest is parallel to the line joining the adjacent CE junctions. The bony junction of the alveolar crest and the lamina dura of the posterior teeth form the sharp angle/junctions. The periodontal lesions have their epicentre located at the alveolar crest. Rounding of these sharp junctions is indicative of the periodontal disease of the early stage**. (CDC, 2015)**



Fig(5):lower periapical views, show the effect of Periodontal disease on lamina dura**. (CDC,2015)**

- **External Root Resorption**

In many cases the aetiology is unknown, but in others causes can be localised inflammatory lesions, reimplanted teeth, tumours and cysts, orthodontic treatment, occlusal forces and impacted teeth. It is commonly seen on cervical and apical regions. When lesion begins at the apex, it causes smooth resorption with blunting of the apex as seen in **Fig(6).**Bone and the lamina dura follow the resorbing root with the normal appearance around the shortened root. However, the external resorption due to periapical inflammation leads to the loss of lamina dura around the apex.**(Alejandro, 2016)**



Fig(6):upper periapical view, External root resorption.**(Alejandro, 2016)**

- **Traumatic Injury to Teeth**

A. **Occlusal trauma**:

Traumatic occlusion results into degenerative changes in the tooth supporting structure and gives radiographic findings which include widening of the periodontal ligament space, widening of the lamina dura, an increase in the number and size of trabeculae.Depending on

the extent of the traumatic force and the individual's physiological resistance, the widened periodontal space returns to its normal appearance after the elimination of the trauma.Concussion indicates crushing injury to vascular structures at the tooth apex and to the periodontal ligament space radiographically seen as apical widening of periodontal ligament space because of the raising of the tooth out of the socket as seen in **Fig(7).(Alberto, 2012)**

B. **Subluxation**

Denotes an injury to supporting structures of the tooth that results in abnormal loosening of tooth without frank dislocation. Radiographically there is periapical widening of the periodontal ligament space**.(Horse, 2012)**

C. **Avulsion**:

In recent avulsion the lamina dura of empty socket is apparent and usually persists for several months**.(Nurulnazra, 2017)**

Fig(7):upper periapical view,shows effect of Occlusal trauma on lamina dura**. (Nurulnazra, 2017)**

- **Malignancy**:

In squamous cell carcinoma the evidence of invasion of bone around teeth may first appear as an irregular widening of periodontal ligament space with effacement or loss of lamina dura

a) **Osteosarcoma**

Is a malignant neoplasm of bone in which osteoid is produced directly by malignant stroma. There is band-like widening of periodontal ligament space**.(Lavanya, 2014)**

b) **Leukaemia**

Is a malignant tumour of haematopoietic stem cells. The lamina dura and cortical outlines of follicles may be effacted. If lesions affect the periodontal structures, the crestal bone may be lost. Leukaemic infiltration of the mandible may lead to generalised rarefaction and destruction of the lamina dura and the irregular widening of the periodontal ligament space**.(Hutter, 2010)**

c) Multiple myeloma

Is a malignant neoplasm of plasma cells. Lamina dura and follicles of impacted teeth may lose their typical corticated surrounding bone in a manner analogous to that seen in hyperparathyroidism.**(Raab, Podar, 2009)**

Fig(8):occlusal view,Multiple myeloma.**(Raab, 2009)**

- **Traumatic Bone Cyst**

It is a cavity within bone lined by connective tissue. Often the lesion involves bone around the roots of the teeth but leaves the lamina dura intact or only partially disrupted**.(Cortell-Ballester, 2009)**

Fig(9): Panoramic view(OPG),Traumatic Bone Cyst**.(Cortell-Ballester, 2009)**

- **Periapical Cemental Dysplasia**

In this there is localised change in normal bone metabolism. Periapical normal lamina dura involved and lost, either making the periodontal ligament space less apparent or giving it a wider appearance.**(Joinville, 2012)**

Fig(10):lower periapical view, Periapical Cemental Dysplasia**.(Joinville, 2012)**

- ## Central Giant-cell Granuloma

It is thought to be a reactive lesion which often displaces and resorbs the root of the involved teeth with loss of lamina dura**. (Deepanshu, 2015)**

Fig(11):panoramic view(OPG),Central giant-cell granuloma**.(Deepanshu, 2015)**

- ## Fibrous Dysplasia

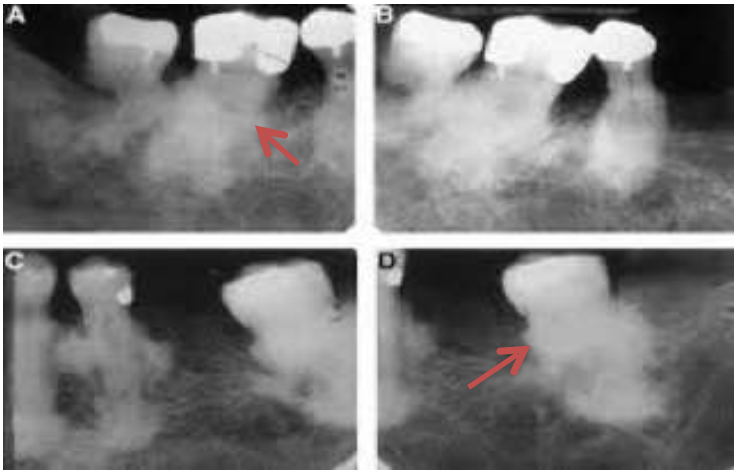
It results from localised change in normal bone metabolism. There is gradual blending of normal trabecular bone into an abnormal

trabecular pattern. Often the bone surrounding the tooth is altered without affecting the dentition and a distinct lamina dura disappears due to abnormal bone changes. If the bone density increases, the periodontal ligament space may appear to be very narrow as seen in **Fig(12).(Boyce, 1993)**

Fig(12):sagittal view of CBCT,Fibrous Dysplasia.**(Boyce, 1993)**

- **Paget Disease**

It is a condition of abnormal resorption and apposition of osseous tissue in one or more bones. The cortical boundaries become granular and less apparent as sharp boundaries and lamina dura may become less evident and altered into the abnormal bone pattern**. (Paul, 2017).**



Fig(13):lower periapical views,shows effect of Paget disease on lamina dura**.**
(Paul,2017)

- **Dental caries**

Tooth decay, also known as dental caries or cavities, is the breakdown of teeth due to acids made by bacteria. The cavities may be a number of different colors from yellow to black. May cause early loss of teeth and loss of lamina dura.**(Davis, 2013) (Laudenbach, 2014)**

Fig(14):lower periapical view,shows the effect of Caries on lamina dura**.**
(Davis,2013)

- **Gingivitis**

Gingivitis is a non-destructive disease that causes inflammation of the gums. The most common form of gingivitis, and the most common form of periodontal disease overall, is in response to bacterial biofilms (also called plaque) that is attached to tooth

surfaces, termed (plaque-induced gingivitis).May cause loss of lamina dura of teeth.**(Margaret, 1989)**

- **Sclerosing osteomyelitis**

Garre's sclerosing osteomyelitis is a type of chronic osteomyelitis also called periostitis ossificans and Garré's sclerosing osteomyelitis. It is a rare disease.May cause dental periapical opacity ,Loss of lamina dura of teeth and multiple opaque jaw lesions as seen in **Fig(15).(Suma, 2007)**

Fig(15):panoramic view(OPG),Sclerosing osteomyelitis**.(Suma, 2007)**

Table(2): Types of generalised loss of lamina dura.**(Molly, 2014)**

B-Generalised		

- **Idiopathic**
- **Hyperparathyroidism**
- **Cushing Syndrome**
- **Renal Osteodystrophy**
- **Rickets and Osteomalacia**
- **Hypophosphatasia**
- **Hypothyroidism**
- **Thalassaemia**
- **Age-related Changes in Lamina Dura**
- **Prolonged Steroid Therapy**

• Idiopathic

There is firm relationship between this pathological condition of lamina dura and resorption of root.Well-recognized causes of apical root resorption in permanent teeth include orthodontic therapy, trauma, periapical or periodontal inflammation, tumors, cysts, occlusal stress, impacted teeth, systemic conditions, endocrine imbalances and dietary habits. When none of these causes are present, it is termed idiopathic root resorption which may be either cervical or apical. Multiple idiopathic apical root resorption is a rare condition which is usually detected as an incidental radiographic finding.So that will make as a result(idiopathic pathological lamina dura).**(Joel, 2012)**

• Hyperparathyroidism

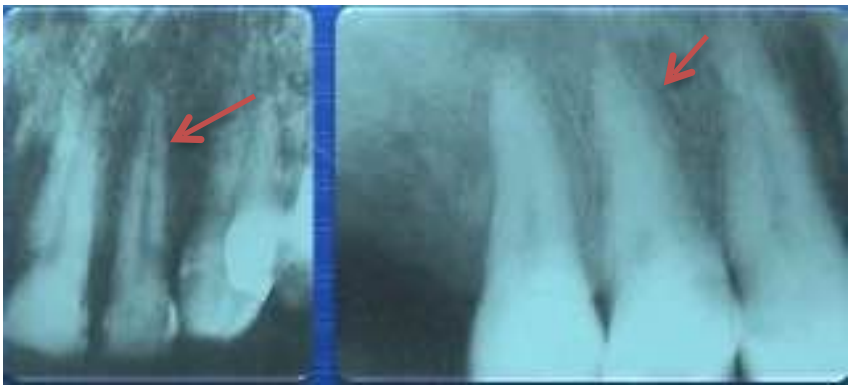
There is an excess of circulating parathyroid hormone which increases bone remodelling in preference of osteoclastic bone resorption, which mobilises calcium from skeleton. About 10% of patients show loss of lamina dura (either partial or complete).

Depending on duration and severity of the disease, loss of the lamina dura may occur around one tooth or all the remaining teeth.**(Sunita, 2015)**

Fig(16):panoramic view(OPG), shows effect of hyperparathyroidism on lamina dura. **(Sunita, 2015)**

- **Cushing Syndrome**

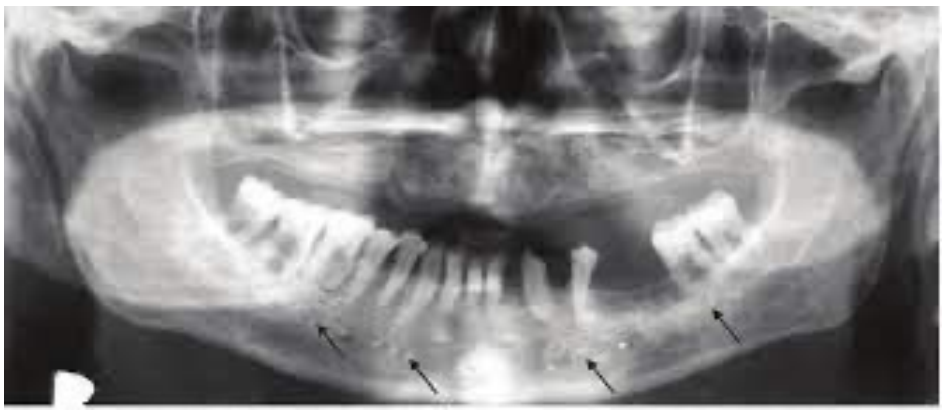
It results from an excess secretion of glucocorticoids by adrenal glands that results in a loss of bone mass. The primary radiographic appearance is generalised osteoporosis which may have granular bone pattern and the partial loss of lamina dura or thinning may occur.**(Nemdis, 2008)**



Fig(17):upper periapical views,show the effect of Cushing Syndrome on lamina dura.**(Nemdis, 2008)**

- ## Renal Osteodystrophy

In this condition, the bone changes result from chronic renal failure. The radiographic appearance is a decrease or an increase in number of internal trabeculae, and the trabecular bone pattern may be granular. The cortical boundaries and lamina dura may be thinner or less apparent**.(Yaxley, 2016)**



Fig(18):panoramic view(OPG),shows effect of renal osteodystrophy on lamina dura.**(Yaxley, 2016)**

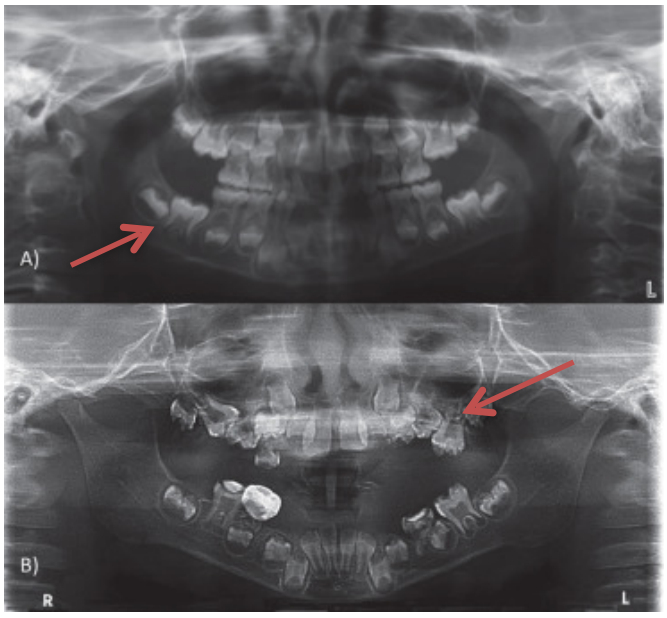
- ## Rickets and Osteomalacia

These conditions result from inadequate serum and extracellular levels of calcium and phosphate, minerals required for the normal calcification of bone and teeth. In rickets the jaw cortical structures may be thin. The trabeculae become reduced in density, number and thickness. Overall radiolucent appearance and sparse trabeculae are seen. In long-standing or severe cases lamina dura may be thin, sparse or entirely absent and cortical boundaries of the follicles may be thinned/missing.**(NCATS Program, 2013) (McKee, 2021)**

Fig(19):upper periapical view,shows effect of Osteomalacia on lamina dura.
(McKee,2021)

- **Hypophosphatasia**

In this condition there is reduced production or defective function of alkaline phosphatase. This enzyme is required for normal mineralisation of osteoid. A generalised reduction in bone density may occur in adults. In jaws a generalised radiolucency of the mandible and maxilla is evident and cortical bone and lamina dura is thin as seen in **Fig(20).(Rena, 2021)**



Fig(20):panoramic view(OPG),shows effect of Hypophosphatasia on lamina dura.**(Rena,2021)**

- **Hypothyroidism**

It results from insufficient secretion of thyroxin by the thyroid glands. Effects on teeth include delayed eruption, short roots and thinning of lamina dura.**(Preedy, 2009)**

- **Thalassaemia**

It results in defect in haemoglobin synthesis. Radiographic feature results from hyperplasia of ineffective bone marrow and its subsequent failure to produce normal red cells. The jaws appear radiolucent with thinning of cortical borders and enlargement of the marrow spaces. The lamina dura is thin and the roots of the teeth may be short.**(L. Nhlb, 2012)**

Fig(21):upper periapical view,shows effect of Thalassaemia on lamina dura**. (L.Nhlb,2012)**

- **Age-related Changes in Lamina Dura:**

The rate of bone loss increases between the ages of 33 and 57 years and between 65 and 75 years, in subjects with chronic obstructive pulmonary disease, and with systemic changes, although age-related alterations in the periodontium may not inevitably be manifested with the loss of alveolar bone. hypothesized that such a decline of the lamina dura correlates with age after eruption through hard cortical bone covering the mandibular third molar. Therefore performed a cross-sectional study to show a relationship between loss of the lamina dura below the crown and age including marginal bone levels and the dental status using a panoramic radiograph.**(Minoru, 2009)**

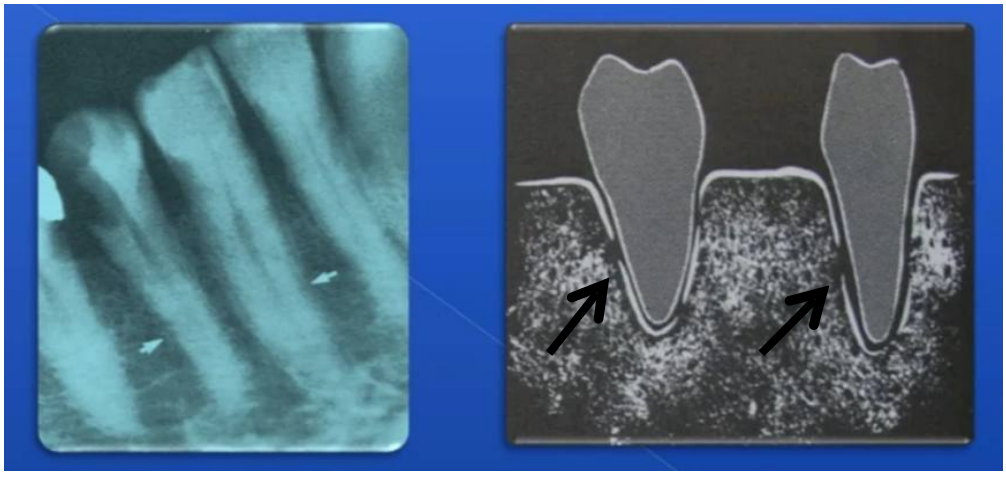
Fig(22):panoramic view(OPG),shows the effect of aging on lamina dura**.**
(Minoru,2009)

Osteoporosis**:** it's kind of age related changes in lamina dura occurs with the ageing process of bone and can be considered a variation of normal. The generalised decrease in bone mass because of an imbalance in bone resorption and formation

results in overall reduction in the density of bone. On occasion the lamina dura may appear thinner than normal.**(Golob, 2015)**

- **Prolonged Steroid Therapy**

It can produce side effects simulating Cushing syndrome and all the changes observed in Cushing syndrome may be present, e.g. it can produce osteoporosis and small areas of loss of lamina dura.**(Nussey, Whitehead, 2001)**



Fig(23):lower periapical view,shows the effect of prolong corticosteroid therapy on lamina dura.**(Whitehead ,2001)**

Chapter two

Discussion

In 1953, Richey and Orban, thought that the lamina dura indicated changes in periodontal health.

In 1963, Manson concluded that the lamina dura was a radiographic artifact, a tangential bony radio-opacity of no clinical significance and inconsistent with disease and trauma .

In 1981, Greenstein et al. thought that the lamina dura was unrelated to the presence or absence of clinical inflammation.

In 1994, Rams et al. said that the crestal lamina dura could be used in predicting periodontal health or disease activity.

Chapter three

Conclusion

Lamina dura is an important structure in radiographic interpretation which has various appearances not only in pathologies but also in normal course. Therefore, its integrity is a valuable adjunct to diagnosis.

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