Review Article

Significance of Lamina Dura - A Review

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A B S T R A C T

The appearance of the lamina dura is a valuable diagnostic feature; any deviation is highly suggestive if not indicative of an abnormal condition. Dentists often the first to detect a serious general condition from recognition of local oral changes. The dentist are therefore advised to consider other signs and symptoms, as well as the integrity of the lamina dura, when establishing diagnosis and treatment of local and systemic disorderLamina Dura is a thin layer of compact bone that lines the tooth socket. A radiograph of sound teeth in a dental arch demonstrates that the tooth socket are bounded by a thin radiopaque layer of dense bone. Its name, lamina dura ("hard layer") is derived from its radiographic appearance.

Key words: Alveolus, Cribriform Plate, Alveolar Bone Proper, Bundle-Bone.

INTRODUCTION

A radiograph of sound teeth in a dental arch demonstrates that the tooth socket are bounded by a thin radiopaque layer of dense bone. Its name, *lamina dura* ("hard layer") is derived from its radiographic appearance. The name lamina dura (or alveolus) is applied to the thin layer of dense cortical bone (the so – called cribriform plate or alveolar bone proper) which lines the normal tooth socket. On the radiograph it produces a thin white or radiopaque shadow since it is caused by a thin layer of dense bone. On the tooth side, a thin dark shadow represents the space occupied by a periodontal membrane; and on the opposite aspect lies the cancellous bone of the alveolar process. It is continuous with the shadow of the cortical bone at the alveolar crest.[1] The lamina dura surrounds the tooth during development with an egg-shell like effect.After eruption, the lamina dura is observed as a thin radiopaque layer of dense bone around sound teeth in a normal dental arch, and is continuous with the shadow of the cortical bone at the alveolar crest.[2]

NORMAL RADIOGRAPHIC APPEARANCE

1. In cases where the mesial or distal aspects of the tooth are flat, the adjacent lamina dura is also flat, and the rays will pass between the teeth in the direction of the bucco-lingual axis of the lamina dura and there will be a narrow shadow of good density.
2. In cases where the mesial or distal aspects of the tooth are not flat (where the root is inclined even so slightly), the lamina dura will be slightly oblique to the rays and the shadow will be wider.

Rays are able to penetrate and so the shadow of the lamina dura in the second case is wider than in the first, it is also dense and less white, because the total amount of dense bone which the beam of rays must penetrate is small.

3. Where the mesial or the distal surface of the root is sharply convex, only a very small fragment of the lamina dura at the extreme summit of the convexity will be portrayed in the radiograph and it will be relatively gray because the amount of bone penetrated is small.
4. If the shape of a tooth is such that the two separate portions of the mesial or the distal surface lie one behind the other, there may be two lamina dura shadows on that aspect of the root. The mesial aspect of the mesial root of the lower first molar is a good example of this. The lower cuspid is another example: because the lingual portion of the root is narrower than the labial portion, four portions of the corresponding lamina dura are often visible in radiographs. It is this tooth, above all others, which causes the dentist difficulty when it comes explaining the multiplicity of lamina dura shadows. If one bears in mind the great variety of shapes of the roots of teeth and the physical factors which enter into the production of the shadow of the lamina dura, it is easy to understand why there must be great radiographic differences in the lamina dura.Differences in thickness, density, shape and number of shadows would be expected merely form the study of

cross sections of sockets seen in the dried skulls. It is seen, therefore, that there must be variations in the width of normal lamina dura shadows, owing to differently shaped teeth, and that the lamina dura always confirms to the shape of the teeth.

For e.g. the anterior root of the lower first molar. This root is often dumbbell – shaped and so the buccal portion obscures, in part at least, the lingual portion. The penetration of the rays is such that in some cases the lamina dura over the mesial aspect of the obscured root may be seen, if not clearly, at least to some extent. Similarly, when the surface of the root is a smooth single curve, the lamina dura at the extreme apex of the curve is visible. Part of lamina dura which is little below the summit of the curve may also enter into the composition of the lamina dura shadow, because the x-rays are able to penetrate the small amount of tooth substance which stands in the way.[3]

All these differences in the radiographic appearances of the lamina dura have no clinical significance so long as the lamina dura is continuous around the root, with few exceptions; discontinuity is evidence of abnormality, usually disease.

The widely held belief that a broad shadow indicates sclerosis of the lamina dura, the result of some stress or infection, cannot be substantiated. In sclerosis of the bone with involvement of the lamina dura, it is inconceivable that the adjacent bone will not be affected also.

The essential feature in radiographic interpretation is that the shadow of the lamina dura shall be continuous throughout its extent: any deviation from this – any slight deficiency or discontinuity – is highly suggestive, if not quite indicative, of an abnormal condition.

In almost every normal tooth, the lamina dura can be traced from the crest, around the root and into the bifurcation or trifurcation. There are, of course, some anatomic foramens in the lamina dura, but these are not apparent in radiographs.[4]

Difficulties in interpretation of lamina dura shadow

The absorption of the x-rays depends not only on the physical density of the substance but also on the thickness.

Teeth with slender end

In teeth which end in slender points, there can be only a very small circle of lamina dura around the apices. The circle may be so small that there is insufficient thickness, at any given point to produce a radiographic shadow. In such a case, there may be an apparent absence of lamina dura without disease.

It is true that many lamina dura shadows are thin and of poor contrast, but with the aid of magnifying glass and proper light, they can be seen, except in the presence of disease or under the condition just described.

Upper cuspids

The teeth that are most likely to present difficulty in tracing the lamina dura around the apex are the upper cuspids. Very fine, very small amount of bone in the lamina dura is much too delicate to form a contrast with the adjacent bone. An area of increased radiolucency of very small size is sometimes observed at the apex of the upper cuspid. When this condition is present and there is inability to trace the lamina dura, differentiation between a normal and a pathologic condition is beyond radiographic study alone and clinical methods must be used. The fact that such radiolucencies may appear as normal shadows must

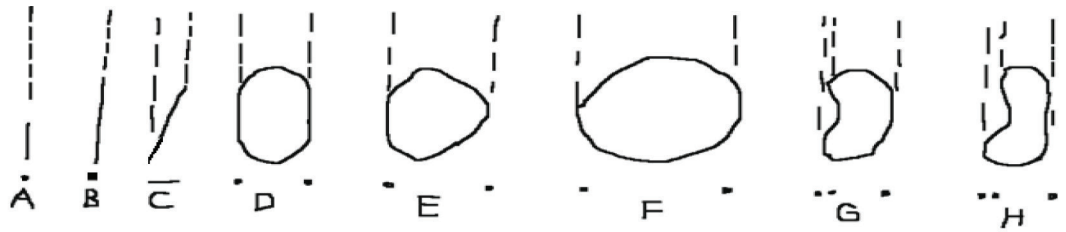

Figure-1: Diagrammatic representation of the radiographic projection of lamina dura.
A – short length of compact bone with x – rays passing through long axis resulting in narrow sharp dense shadow.
B - much longer length of compact bone with rays directed through long axis; shadow denser than A
C – same position of bone, with rays at an angle so that the greatest amount of bone traversed is width of the bone; shadow wide but of poor density.
D – cross – section of lower incisor socket. Mesial and distal margins of equal length and x – rays penetrate long axis; shadows of two aspects narrow sharp dense and equal.
E – transverse section of lamina dura of cuspid. Left hand line is long and straight, producing dense white and narrow shadow. The opposite border is convex and rays only pass through the summit producing gray shadow of poor definition.
F – transverse section of lamina dura of molar. Mesial and distal borders curved and unequal on two sides of socket. Left hand shadow will be of less density because of less bone in the axis of beam of rays. Neither shadow will be sharp because of curvature of the dense bone.
G - transverse section of bicuspid socket. Interrupted lines represent rays and planes along which shadow of lamina dura projected. Two shadows could be expected on left, both of poor density because of small amount of dense bone to be penetrated.
H – anterior socket of lower molar. Dumbbell shape of socket to conform with root suggests that three or more shadows may be projected as indicated by dotted lines.[1]

be kept in minds so that there will be undue concern and no improper treatment.

Another site presenting difficulty in interpretation is the upper bicuspid in children whose teeth have not fully developed. While in most cases it is possible to identify the lamina dura around the root that has developed and extended to cover the dental papilla, in some quite normal cases it is not possible to see the lamina dura at the apex. This is especially true if the bicuspid is rotated. In any other area the condition would almost certainly indicate disease. In the upper bicuspid area, such an appearance may be normal, but the possibility of disease must be borne in mind.Superimposition of the foramen over the roots results in a lesser degree of whiteness of the lamina dura.

E.g. Incisive foramen – Upper incisors,Mental foramen – Superimposition over the lower premolar roots,Superimposition of nose over the shadow of upper anterior teeth.[5]

Variations of the lamina dura shadow

Wide variations in the thickness of the lamina dura are seen not only around different teeth in the same mouth but in a single tooth. This variation in width and density of the lamina dura shadow are the result of differences in the shape and contour of the roots or root.

Thickness and density of lamina dura on the radiograph vary with the amount of the occlusal stress to which the tooth is subjected. Lamina dura is wider and denser about the roots of teeth in heavy occlusion and thinner and less dense about the roots that are not subjected to occlusal forces.In the absence of any change in the bone immediately adjacent to lamina dura it must be regarded as a normal variation. With the few exceptions, as in case of upper cuspids mentioned above, lack of continuity of the lamina dura indicates abnormality (infection of the bone). Even very small discontinuity has significance. The presence of intact lamina dura around the apex of the tooth strongly suggests a vital pulp. Acute peri-apical infection may occasionally occur in which there has not been sufficient time erosion of the lamina dura to occur. Total or almost absence of lamina dura of all teeth is an accompaniment of some abnormal condition. Dentists often are the first to detect a serious general condition from the recognition of local oral changes.Absence of all or nearly all, lamina dura shadows is usually evidence of general decalcification of the skeleton.

With few exceptions, lack of continuity of the Lamina dura indicates abnormality or the infection of the bone. Every small discontinuity has significance.There are very few rare occasions when discontinuity of the shadow of Lamina dura is the result of normal anatomic arrangements for e.g. apex of upper cuspids.The presence of intact lamina dura around the apex of a tooth strongly suggests a vital pulp. Acute peri-apical infection may occasionally occur in which there has not been sufficient time for the erosion of the lamina dura to occur.

Loss of Lamina Dura

Change in Lamina dura may be the only osseous abnormality apparent in radiographs in the presence of generalized osteoporosis, if the amount of calcified material removed from the skeleton has been insufficient to be revealed on the radiographs. ⅓rd to ⅔rd alteration in calcific content of bone must have taken place before any radiographic change becomes apparent, under the usual clinical methods of examination.The teeth are more readily available for radiographic study than any other hard tissue in the body.

LOCALISED LOSS OF LAMINA DURA

1. Common Normal Variations

Apex of Maxillary Canine, Rotated Tooth, Maxillary Premolars – before maturation, Projection over the Maxillary Sinus, Projection over the Mandibular Canal, Projection over the Mental Foramen

2. Pathologic

Inflammatory peri-apical disease, Peri-apical Granuloma, Radicular Cyst, Simple Bone Cyst, Peri-apical Cemental Dysplasia, Osteomyelitis

3. Uncommon

Malignant Tumor, Fibrous Histiocytoma, Histiocytosis X

GENERALISED LOSS OF LAMINA DURA

1. Common

Idiopathic, Paget Disease of Bone, Leukemia.

2. Uncommon

Metastatic Malignancy (especially breast), Hyperparathyroidism, Multiple Myeloma, Osteomalacia, Rickets (Including Vitamin D resistant Rickets), Cushingsyndrome, Hypoparathyroidism, Hypothyroidism, Postmenopausal Osteoporosis, Renal Acidosis, Acromegaly, Oxalosis, Hypervitaminosis D, Hypovitaminosis C

Systemic Sclerosis (Scleroderma),Hypophosphatasia

ACCENTUATION OF LAMINA DURA

Normal variant, Systemic sclerosis (Scleroderma), Osteopetrosis.[6]

EFFECT OF AGE ON THE APPEARANCE OF LAMINA DURA

Decline of the lamina dura correlates with age after

eruption through hard cortical bone covering the mandibular third molar.disruption of the lamina dura increased with age associated independently with bone resorption in the canine and first molar, suggesting that the lamina dura below the crown could not be responsible for alveolar bone resorption of other teeth in the mandible.[2]

CONCLUSION

The appearance of the lamina dura is a valuable diagnostic feature; any deviation is highly suggestive if not indicative of an abnormal condition. Dentists often the first to detect a serious general condition from recognition of local oral changes. The dentist are therefore advised to consider other signs and symptoms, as well as the integrity of the lamina dura, when establishing diagnosis and treatment of local and systemic disorder

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