PATTERNS OF BONE LOSS

Dr.Neeta Bhavsar
Professor & Head
Dept. of Periodontology

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INTRODUCTION:

- Bone is a mineralised connective tissue of the body , composed of both organic and inorganic parts.
- It is exquisitely designed for its role as load bearing structure of the body.
- Formed from a combination of dense compact bone and cancellous bone that is reinforced at points of stress.

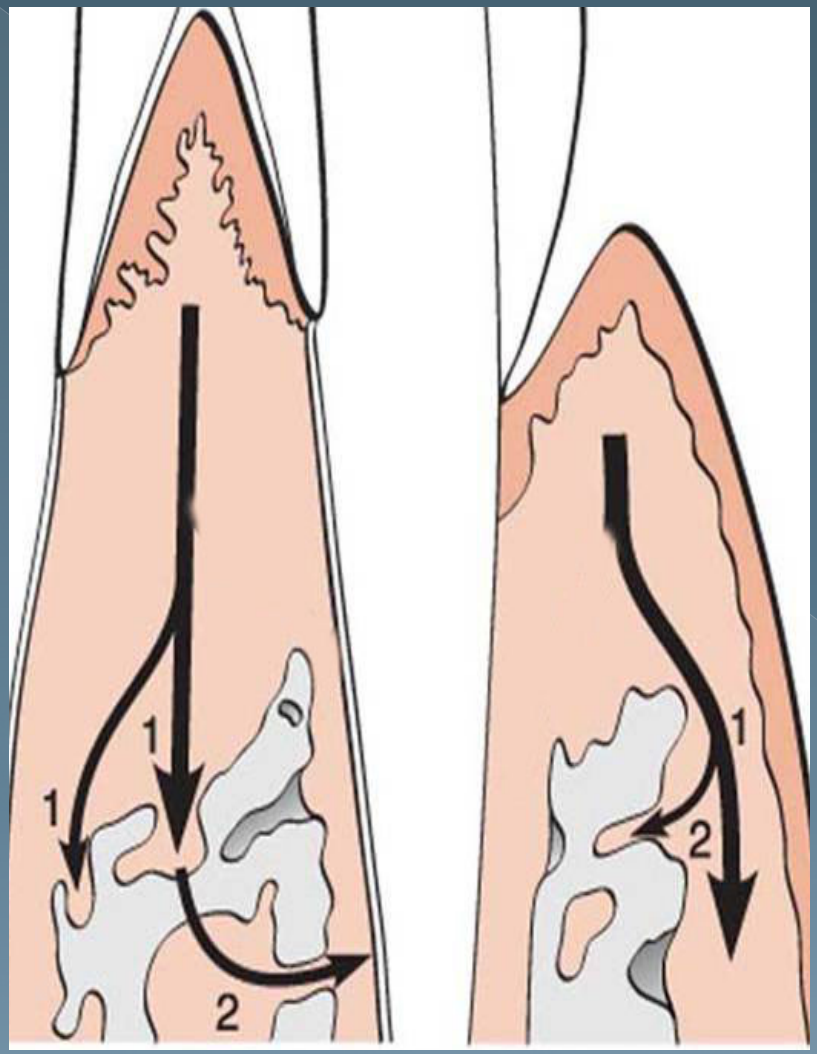
- The height and density of the alveolar bone normally maintained by an equilibrium between bone formation and bone resorption.
- When resorption exceeds formation , both bone height and bone density may be reduced.

BONE DESTRUCTION IN PERIODONTAL DISEASES:

- The most common cause of bone destruction in periodontal disease is the extension of inflammation from the marginal gingiva into the supporting periodontal tissue.
- Gingival inflammation extends along the collagen fiber bundles and follows the course of blood vessels through the loosely arranged tissues around them into the alveolar bone.

PATHWAYS OF INFLAMMATION:

- **Interproximally**, inflammation spreads to the loose connective tissue around the blood vessels, through the fibers, and then into the bone through vessel channels that perforate the crest of the interdental septum at the center of the crest toward the side of the crest or at the angle of the septum.
- Less frequently, the inflammation spreads from the gingiva directly into the periodontal ligament and from there into the interdental septum.



Pathways of inflammation from the gingiva into the supporting periodontal tissues in periodontitis. **A,** Interproximally, from the gingiva into the bone *(1),* from the bone into the periodontal ligament *(2),* and from the gingiva into the periodontal ligament *(3)*. **B,** Facially and lingually, from the gingiva along the outer periosteum *(1),* from the periosteum into the bone *(2),* and from the gingiva into the periodontal ligament *(3)*.

- **Facially and lingually**, inflammation from the gingiva spreads along the outer periosteal surface of the bone and penetrates into the marrow spaces through vessel channels in the outer cortex.

RADIUS OF ACTION:

- **Garant and Cho (1979)** suggested that locally produced bone resorption factors may need to be present in the proximity of the bone surface to exert their action.
- **Page and Schroeder(1982)** on the basis of Waerhaug's measurements made on human autopsy specimens postulated a range of effectiveness of about 1.5 to 2.5 mm in which bacterial plaque can induce loss of bone.

- Beyond 2.5 mm there is no effect.
- Interproximal angular defects can appear only in spaces that are wider than 2.5 mm because narrower spaces would be destroyed entirely.
- Large defects greatly exceeding a distance of 2.5 mm from the tooth surface (as described in aggressive types of periodontitis) may be caused by the presence of bacteria in the tissues

RATE OF BONE LOSS:

- Based on rate of interproximal attachment loss , **loe et al** in **1978** identified 3 subgroups In patients with periodontal disease:

1. Rapid progressive periodontal disease: yearly loss of attachment of 0.1 to 1.0 mm.
2. Moderately progressive periodontal disease: with a yearly loss of attachment of 0.05 to 0.5 mm.
3. Minimal or non progressive periodontal disease: 0.05 to 0.09 mm yearly loss of attachment.

PERIODS OF DESTRUCTION:

- Periodontal destruction occurs in **an episodic**, **intermittent manner**, with periods of inactivity or quiescence, and destructive periods that result in loss of collagen and alveolar bone and deepening of the periodontal pocket.

- Periods of destructive activity are associated with subgingival ulceration and an acute inflammatory reaction, resulting in rapid loss of alveolar bone & with the conversion of a predominantly T-lymphocyte lesion to one with a predominantly B-lymphocyte–plasma cell infiltrate.

- It has also been suggested that the onset of periods of destruction coincide with tissue invasion by one or several bacterial species and is followed by an advanced local host defense that controls the attack.

FACTORS DETERMINING THE PATTERN OF BONE LOSS:

1) NORMAL VARIATION IN ALVEOLAR BONE
2) EXOSTOSES
3) TRAUMA FROM OCCLUSION
4) BUTTRESSING BONE FORMATION
5) FOOD IMPACTION
6) AGGRESSIVE PERIODONTITIS

1.NORMAL VARIATIONS IN ALVEOLAR BONE:

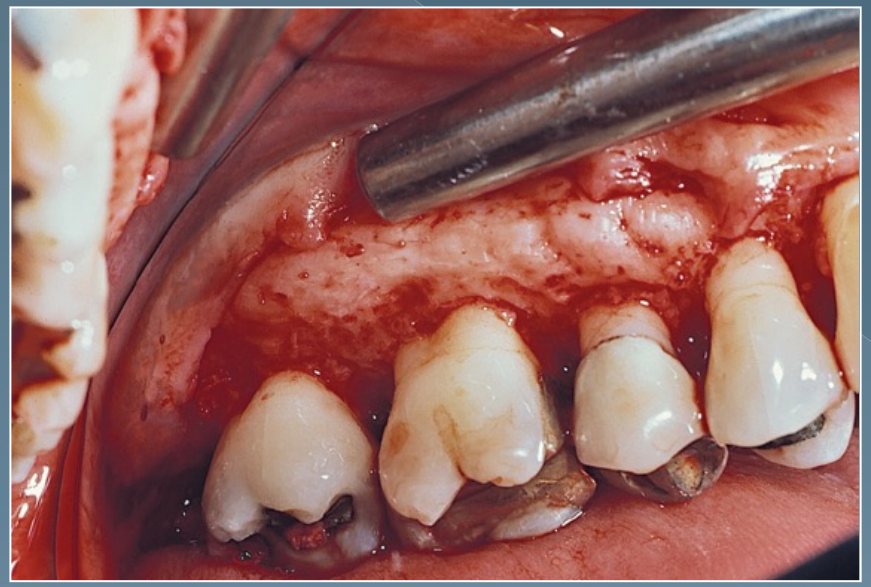
- Variations in the morphologic features of alveolar bone substantially affect the bone destructive pattern in periodontal disease which includes:

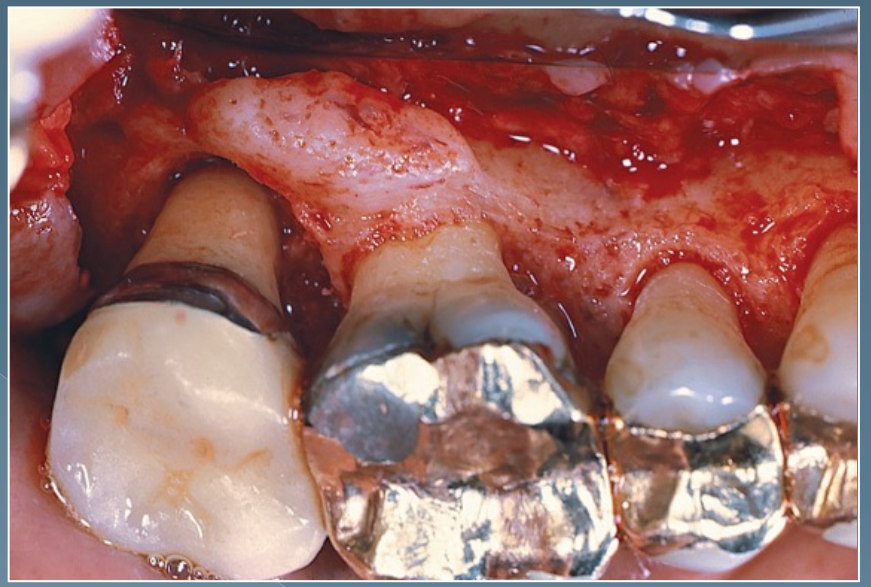
- Thickness ,width & crestal angulation of interdental septa.
- Thickness of the facial and lingual alveolar plate.
- Presence of fenestrations and dehiscences.
- Alignment of the teeth .
- Root and root trunk anatomy.
- Root position within the alveolar process.
- Proximity with another tooth surface

For example, angular osseous defects cannot form in thin facial or lingual alveolar plates, which have little or no cancellous bone between the outer and inner cortical layers. In such cases the entire crest of the plate is destroyed, and the height of the bone is reduced.

2.EXOSTOSES:

- Bony outgrowths that are varied in shape and size.
- Palatal exostoses found In 40% of human skulls.
- Having a large bony mass , responsible for wedge shaped defects.





Bony exostoses on maxillary buccal and palatal surfaces.

3.TRAUMA FROM OCCLUSION:

- Trauma from occlusion may be a factor in determining the dimension and shape of bone deformities.
- It may cause a thickening of the cervical margin of alveolar bone or a change in bone morphology (e.g., angular defects, buttressing bone)

- In the absence persistent trauma from occlusion results in funnel shaped widening of the crestal portion of the periodontal ligament, with resorption of adjacent bone. Resulting in angular shaped defect.

- Trauma combined with inflammation:- Trauma combined with inflammation aggravates bone destruction and causes bizarre bone patterns.

4.Buttressing bone formation:

- Bone formation sometimes occurs in an attempt to buttress bony trabeculae weakened by resorption.
- When it occurs within the jaw, it is termed *central buttressing bone formation.*
- When it occurs on the external surface, it is referred to as *peripheral buttressing bone formation, which* may cause bulging of the bone contour, which sometimes accompanies the production of osseous craters and angular defects

5.FOOD IMPACTION:

- Pressure & irritation from food impaction results in inverted bony architectures.
- Extensive bone destruction by food impaction may lead to poor proximal relationship.

6.Aggressive periodontitis:

- A vertical or angular pattern of alveolar bone destruction is found
- around the first molars in aggressive periodontitis.

ROLE OF SYSTEMIC FACTORS IN BONE DESTRUCTION:

- When a generalized tendency toward bone resorption exists, bone loss initiated by local inflammatory processes may be magnified.
- Periodontal bone loss may also occur in generalized skeletal disturbances (e.g., hyperparathyroidism, leukemia, or histiocytosis X) by mechanisms that may be totally unrelated to the usual periodontal problem.

Bone DESTRUCTION PATTERNS IN PERIODONTAL DISESE:

1) HORIZONTAL BONE LOSS
2) BONE DEFORMITIES(OSSEOUS DEFECTS):

- Vertical/angular defects
- Osseous craters
- Bulbous bony contours
- Reversed architecture
- Ledges
- Furcation involvement

HORIZONAL BONE LOSS:

- The most common pattern of bone loss.
- The bone is reduced in height, but the bone margin remains approximately perpendicular to the tooth surface.
- The interdental septa and facial and lingual plates are affected, but not necessarily to an equal degree around the same tooth.

Horizontal bone loss. Note the reduction in height of the marginal bone, exposing cancellous bone

BONE DEFORMITIES:

- There are different types.
- These usually occur in adults but have also been reported in human skulls with deciduous dentitions.
- Their presence may be suggested on radiographs, but careful probing and surgical exposure of the areas are required to determine their exact conformation and dimensions.

Vertical or angular defects:

- Vertical or angular defects are those that occur in an oblique direction, leaving a hollowed-out trough in the bone alongside the root; the base of the defect is located apical to the surrounding bone
- In most instances, angular defects have accompanying infrabony periodontal pockets; infrabony pockets, on the other hand always must have an underlying angular defect.

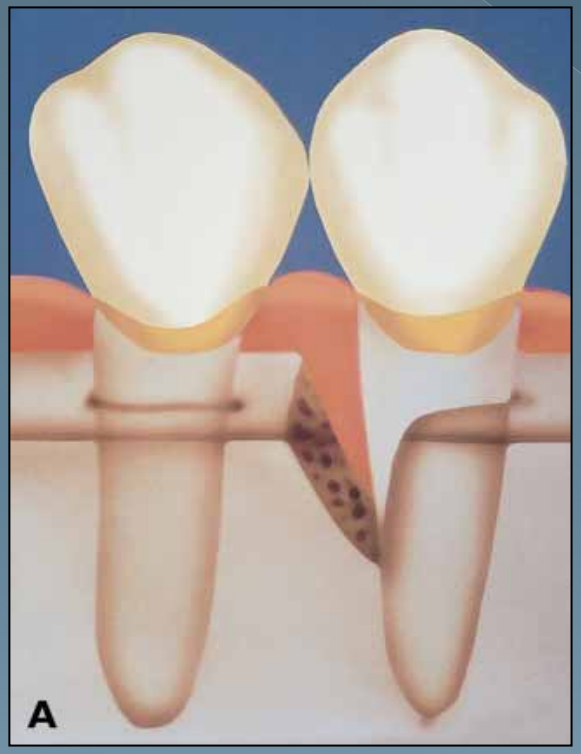
Vertical (angular) bone loss on the distal root of the first molar.

Radiographic view of angular defects

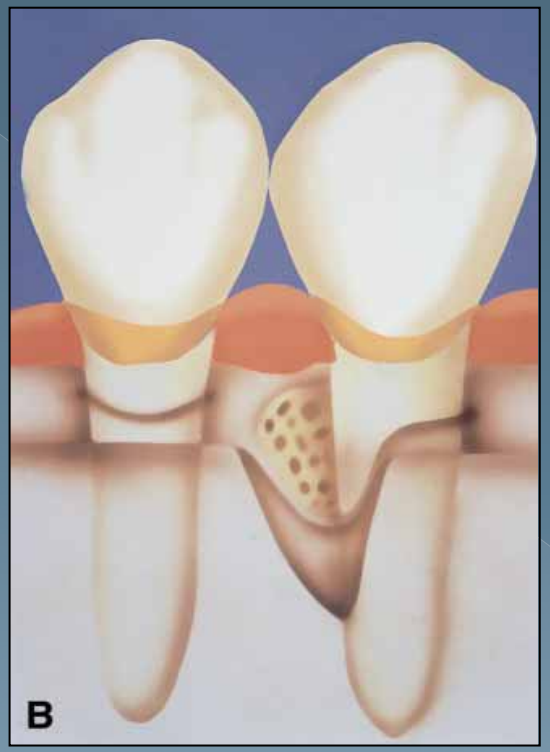
- Goldman and Cohen on the basis of the presence of number of osseous walls. Divided angular defects in_

1. One wall (HEMISEPTUM)
2. Two wall or
3. three wall

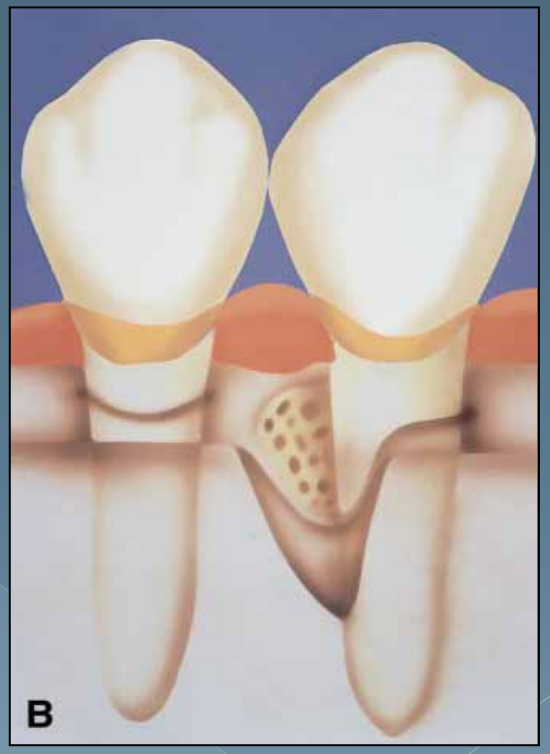
- The number of walls in the apical portion of the defect is often greater than that in its occlusal portion, in which case the term *COMBINED OSSEOUS DEFECT* is used.



ONE WALL DEFECT



TWO WALL DEFECT



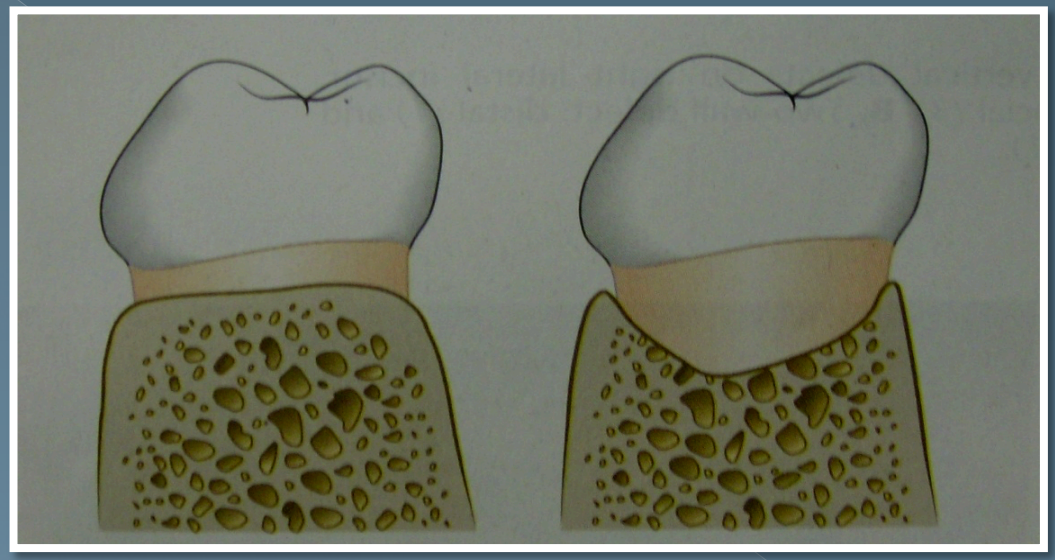
THREE WALL DEFECT

- Diagnosis: Vertical defects occurring interdentally can generally be seen on the radiograph, although thick, bony plates sometimes may obscure them.
- Angular defects can also appear on facial and lingual or palatal surfaces, but these defects are not seen on radiographs. Surgical exposure is the only sure way to determine the presence and configuration of vertical osseous defects.

- Vertical defects increase with age.
- three-wall defects are more frequently found on the mesial surfaces of upper and lower molars.

Osseous craters:

- Osseous craters are concavities in the crest of the interdental bone confined within the facial and lingual walls.
- They make up about 1/3rd of all defects & about 2/3rd of all mandibular defects.
- Twice in posterior segment than in anterior segment of jaw.



Osseous crater in a faciolingual section between two lower molars.left-normal bone contour right-osseous crater.

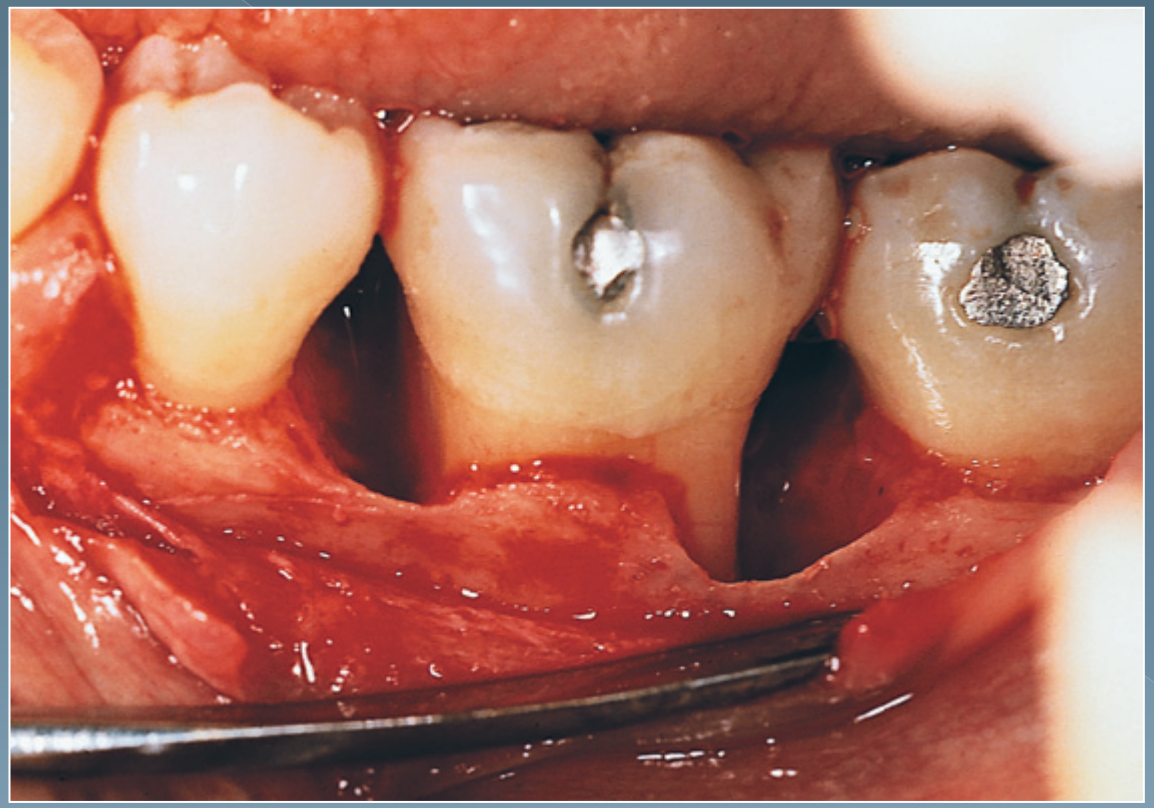
- Reasons for the high frequency of interdental craters:
- The interdental area collects plaque and is difficult to clean.
- The normal flat or even slightly concave faciolingual shape of the interdental septum in lower molars may favor crater formation.
- Vascular patterns from the gingiva to the center of the crest may provide a pathway for inflammation.

Bulbous bony contours:

- They are bony enlargements caused by exostoses, adaptation to function, or buttressing bone formation.
- They are found more frequently in the maxilla than in the mandible.

REVERSED ARCHITECURE:

- Reversed architecture defects are produced by loss of interdental bone, including the facial plates and lingual plates, without concomitant loss of radicular bone, thereby reversing the normal architecture.
- Such defects are more common in the maxilla.



LEDGES:

- Ledges are plateau like bone margins caused by resorption of thickened bony plates.

Ledge produced by interproximal resorption.

FURCATION INVOLVEMENT:

- The term *furcation involvement* refers to the invasion of the bifurcation and trifurcation of multirooted teeth by periodontal disease.
- Mandibular first molars are the most common sites and the maxillary premolars are the least common.

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- ACCORDING TO the amount of tissue destruction **GLICKMAN(1958**) classified furcation involvement as grade I ,II, III,IV.
- **Grade - I:** Incipient or early lesion in which catch is felt in furcation involvement. The pocket is suprabony and primarily affects the soft tissues. Early bone loss may or may not have occurred with an increase in probing depth.
- no radiographic changes are found.

- **Grade - II:** Grade II furcation can affect one or more of the furcations of the same tooth. The furcation lesion is essentially a **Cul de sac** (Cave like) with a definite horizontal component. The extent of horizontal probing of the furcation determine, whether the defect is early or advanced. Vertical bone loss may be present and represents a therapeutic complication

- Radiographic changes may or may not be found.

- **GRADE - III:** Bone is not attached to the dome of furcation.
- The opening may be filled with soft tissues and may not be visible. Indeed one may not be able to pass a periodontal probe completely through the furcation because of interference with the bifurcational ridges or facial/lingual bony margins.
- Properly exposed and angle radiographs of class III furcations display the defect as a **triangular** radiolucent area in the furcation

- **GRADE - IV:** In this inter dental bone is destroyed and the soft tissues have receded apically so that the furcation opening is clinically visible. A tunnel therefore exists between the roots of such an affected tooth. The periodontal probe therefore passes readily from one aspect of tooth to another.

- FACTORS RESPONSIBLE FOR FURCATION INVOLVEMENT:

1. The difficulty & sometimes the impossibility of controlling plaque in furcations.
2. Some studies indicate trauma from occlusion in the etiology of furcation lesion, believing that furcation areas are most sensitive to injury from excessive occlusal forces.
3. Presence of enamel projections into the furcation.

4. Proximity of the furcation to the cementoenamel junction.

5. Presence of accessory pulpal canals in the furcation area, which extend the pulpal inflammation to the furcation.

CONCLUSION:

- The pathophysiology involved in the patterns of bone destruction in periodontal diseases is a combination of destructive and reparative processes.
- The proper understanding of various patterns of bone destruction helps in the proper management and treatment planning of the condition.

THANK YOU…