Periodontology- fourth stage

First semester-Dental calculus
Lec-4

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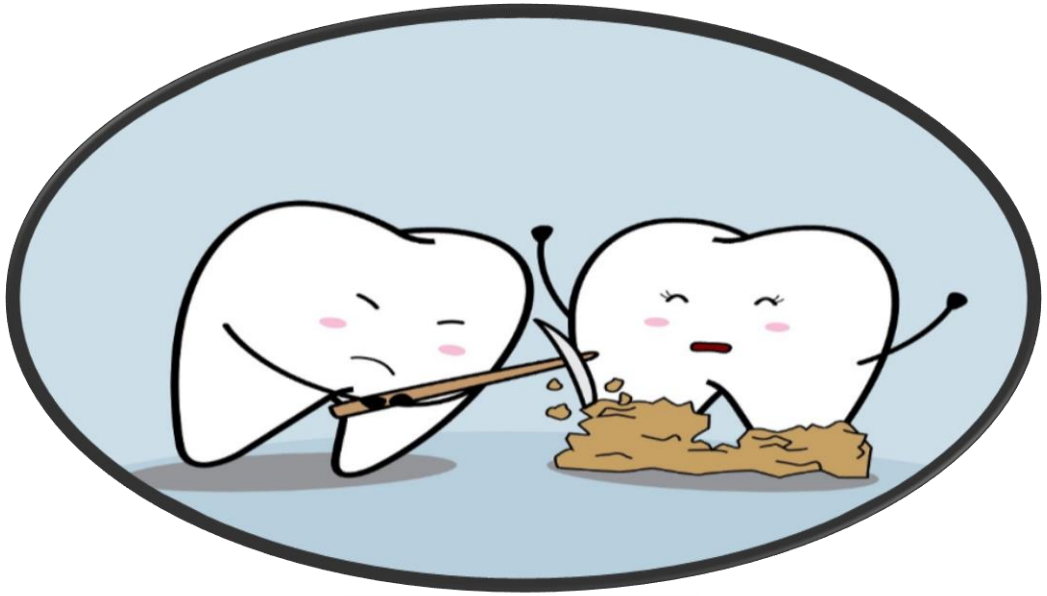

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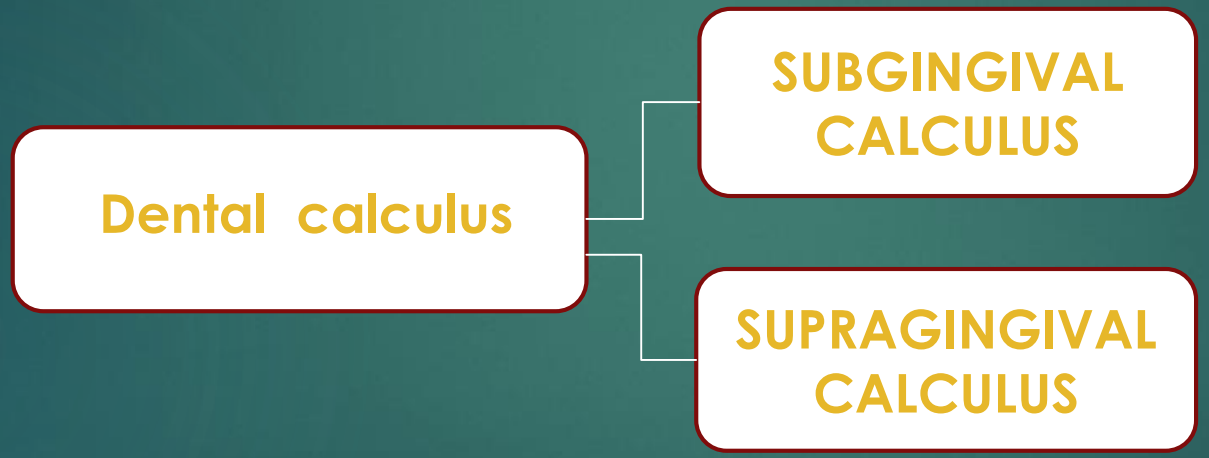
Dental Calculus

- Calculus consists of mineralized bacterial plaque that forms on the surfaces of natural teeth and dental prostheses.

Extensive supragingival calculus is present on the lingual surfaces of the lower anterior teeth.

CLASSIFICATION

- **Dental calculus is classified by its location on a tooth surface as related to the adjacent free gingival margin:**



SUPRAGINGIVAL CALCULUS

- ***Supragingival calculus*** is located coronal to the gingival margin and therefore is visible in the oral cavity.
- It is usually white or whitish yellow in color; hard, with a claylike consistency; and easily detached from the tooth surface.
- The degree of calculus formation is not only dependent on the amount of bacterial plaque present, but also on the secretion of the salivary glands.
- *The* two most common locations for the development of supragingival calculus are the buccal surfaces of the maxillary molars and the lingual surfaces of the mandibular anterior teeth.

SUBGINGIVAL CALCULUS

- ***Subgingival calculus*** is located below the crest of the marginal gingiva and therefore is not visible on routine clinical examination.

- Subgingival calculus is typically hard and dense; it frequently appears to be dark brown or greenish black in color, and it is firmly attached to the tooth surface.

Dark pigmented deposits of subgingival calculus are shown on the distal root of an extracted lower molar.

Composition of dental calculus

- Dental calculus is primarily composed of **inorganic components (70% to 90%)**
- The **organic components and water** constitute the rest.

The major inorganic proportions of calculus are approximately

- 76% calcium phosphate ($Ca_3[PO_4]_2$)
- 3% calcium carbonate ($CaCO_3$)
- 4% magnesium phosphate ($Mg_3[PO_4]_2$)
- 2% carbon dioxide
- And traces of other elements such as sodium, zinc, strontium, bromine, copper, manganese, tungsten, gold, aluminum, silicon, iron, and fluorine

- At least two-thirds of the inorganic component is crystalline in structure:

1. hydroxyapatite, **58%**
2. magnesium whitlockite, **21%**
3. octacalcium phosphate, **12%**
4. brushite, **9%.**

- Generally two or more crystal form are typically found in the sample of the calculus
- **Hydroxyapatite and octacalcium phosphate** are detected most frequently (**i.e., in 97% to 100% of all supragingival calculus**) and constitute the bulk of the specimen.
- **Brushite** is more common in the mandibular anterior region.
- **Magnesium whitlockite is found in the posterior areas.**

- The composition of subgingival calculus is similar to that of supragingival calculus, with some differences

1. It has the same hydroxyapatite content
2. more magnesium whitlockite
3. less brushite and octacalcium phosphate.

- ✓ **The ratio of calcium to phosphate is higher in subgingival calculus, and the sodium content increases with the depth of periodontal pockets.**

❑ Organic Content

- The organic component of calculus consists of a mixture of protein–polysaccharide complexes, desquamated epithelial cells, leukocytes, and various types of microorganisms

Attachment to the Tooth Surface

❖ **Four modes of attachment have been described:**

1) Attachment by means of an organic pellicle.

2) Mechanical locking into surface irregularities, such as caries lesions or resorption lacunae.

3) Close adaptation of the undersurface of calculus to depressions or gently sloping mounds of the unaltered cementum surface.

4) Penetration of bacterial calculus into cementum.

Undersurface of subgingival calculus *(C)* previously attached to the cementum surface *(S)*. Note the impression of cementum mounds in the calculus *(arrows)*.

❖ Formation

- Calculus is *mineralized dental plaque.* The soft plaque is hardened by the precipitation of mineral salts, which usually starts between the 1st and 14th days of plaque formation.
- **Calcification** has been reported to occur within as little as 4 to 8 hours.
- Calcifying plaques may become 50% mineralized in 2 days and 60% to 90% mineralized in 12 days.
- All plaque does not necessarily undergo calcification. Early plaque contains a small amount of inorganic material, which increases as the plaque develops into calculus.
- Microorganisms are not always essential in calculus formation, because calculus readily occurs in germ-free rodents.

- Early plaque of heavy calculus formers contains **more calcium, three times more phosphorus, and less potassium** than that of non calculus formers, suggesting that phosphorus may be more critical than calcium for plaque mineralization.

- Calcification entails the binding of calcium ions to the carbohydrate–protein complexes of the organic matrix and the precipitation of crystalline calcium phosphate salts. Crystals form initially in the intercellular matrix and on the bacterial surfaces and finally within the bacteria.

- The initiation of calcification and the rate of calculus accumulation vary among individuals, among tooth variety in the same dentition, and at different times in the same person.

- On the basis of these differences, persons may be classified as **heavy**, **moderate**, or **slight calculus formers** or as **non calculus formers**.

- Calculus formation continues until it reaches a maximum, after which it may be reduced in amount. The time required to reach the maximal level has been reported to be between 10 weeks and 6 months.

Theories Regarding the Mineralization of Calculus

- **The theoretical mechanisms by which plaque becomes mineralized can be stratified into two categories:**

1. Mineral precipitation results from a local rise in the degree of saturation of calcium and phosphate ions, which may be brought about in several ways:

A. A rise in the pH of the saliva causes the precipitation of calcium phosphate salts. The pH may be elevated by the loss of carbon dioxide and the formation of ammonia by dental plaque bacteria or by protein degradation during stagnation.

B. *Colloidal proteins in saliva bind calcium and phosphate ions ,thus producing supersaturated solution. With* the stagnation of saliva, colloids settle out, and result in the precipitation of calcium phosphate.

C. *Phosphatase liberated from dental plaque, desquamated epithelial cells, or bacteria precipitates calcium phosphate by hydrolyzing organic phosphates in saliva, thereby increasing the concentration of free phosphate ions.*

2. Seeding agents induce small foci of calcification that enlarge and coalesce to form a calcified mass.This concept has been referred to as the *epitactic concept* or, more appropriately, as *heterogeneous nucleation.* The seeding agents in calculus formation are not known, but it is suspected that the intercellular matrix of plaque plays an active role. The carbohydrate–protein complexes may initiate calcification by removing calcium from the saliva (chelation) and binding with it to form nuclei that induce the subsequent deposition of minerals.

Role of Microorganisms in the Mineralization of Calculus

- Mineralization of plaque generally starts extracellularly around both gram-positive and gram-negative organisms, but it may also start intracellularly. Mineralization spreads until the matrix and the bacteria are calcified.

❖ **Other Predisposing Factors contribute to calculus accumulation**

❖ **Iatrogenic Factors**

- Deficiencies in the quality of dental restorations or prostheses are contributing factors to gingival inflammation and periodontal destruction. Inadequate dental procedures that contribute to the deterioration of the periodontal tissues are referred to as *iatrogenic factors.*

❑ Margins of Restorations

Overhanging margins of dental restorations contribute to the development of periodontal disease by

(1) changing the ecologic balance of the gingival sulcus to an area that favors the growth of disease-associated organisms (predominantly gram-negative anaerobic species) at the expense of the health-associated organisms (predominantly gram-positive facultative species)

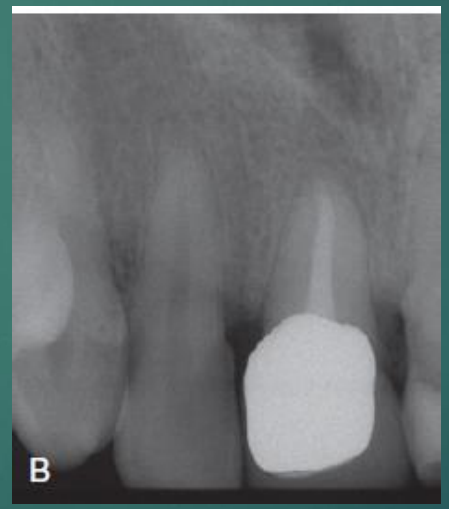
(2) inhibiting the patient's access to remove accumulated plaque.

Radiograph of an amalgam overhang on the distal surface of the maxillary second molar

❑ *Contours and Open Contacts*

- Over contoured crowns and restorations tend to accumulate plaque and handicap oral hygiene measures in addition to possibly preventing the self-cleaning mechanisms of the adjacent cheek, lips, and tongue.

- Restorations that fail to reestablish adequate interproximal embrasure spaces are associated with papillary inflammation



(A) Inflamed marginal and papillary gingiva adjacent to an over contoured porcelain-fused-to-metal crown.(B) Radiograph of an ill-fitting porcelain-fused-to-metal crown

❑ *Design of Removable Partial Dentures*

- Several investigations have shown that, after the insertion of partial dentures, mobility of the abutment teeth, gingival inflammation, and periodontal pocket formation all increase.

- This is because partial dentures favor the accumulation of plaque, particularly if they cover the gingival tissue.

- The presence of removable partial dentures induces not only quantitative changes in dental plaque but also qualitative changes, thereby promoting the emergence of spirochetal microorganisms.

❑ Malocclusion

- The irregular alignment of teeth as found in cases of malocclusion may facilitate plaque accumulation and make plaque control more difficult.

Inflamed palatal gingiva associated with a maxillary provisional acrylic partial denture

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