INTRODUCTION

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Definitions:

Pathology: is the study of a disease. It describes the cause, course and termination of disease.

Oral pathology: it is the science dealing with oral diseases.

Disease: describes a state in which there is a sufficient deviation from normal state for signs or symptoms to be produced.

Signs: describe the apparent features of the patients that doctor see or feel during examination.

Symptoms: describe the patient's complains.

Aetiology: the cause of the disease.

Pathogenesis: how the development of the lesion or disease occur.

Idiopathic: unknown cause.

Predisposing factors: helping factors.

Lesion: it is the variations from normal in part of the body.

Syndrome: a condition in which a collection of signs or symptoms unrelated to each other is present.

Hereditary = Genetic: any trait transmitted through genes from parents to children

Autosomal: a trait transmitted by a gene carried on any of the 22 pairs of chromosomes other than X or Y sex chromosomes.

Sex-linked: a trait transmitted by a gene carried on one of the sex chromosomes. It is sometimes called ***X-linked*** as most of the traits are carried on the X chromosome.

Trait: a characteristic.

Dominant trait: any trait present on only one chromosome for its effect to appear.

Recessive trait: any trait present on the two chromosomes for its effect to appear.

Acquired = Environmental: any developmental error caused by environmental factor.

Congenital: any developmental error appears at birth.

Teratotogenes: any agent can induce or increase the incidence of congenital malformation.

Teratogenic agents include the following:

- Radiation.
- Infection.
- Temperature extremes.
- Oxygen tension.
- Chemicals (drugs or pollution).
- Nutritional imbalance.

Effect of teratogenes depend on:

- Time of exposure.
- Stage of development.
- Dose of the agent.

Results of the exposure to the teratogenes:

- Congenital malformation.
- Growth retardation.
- Functional disorders.
- Death and abortion.

DEVELOPMENTAL DISTURBANCES OF TEETH AND CALCIFIED DENTAL TISSUES

Normal development of teeth:

Morphological classification:

- Bud stage.
- Cap stage.
- Early bell stage.
- Late bell stage.

Histo-physiological classification:

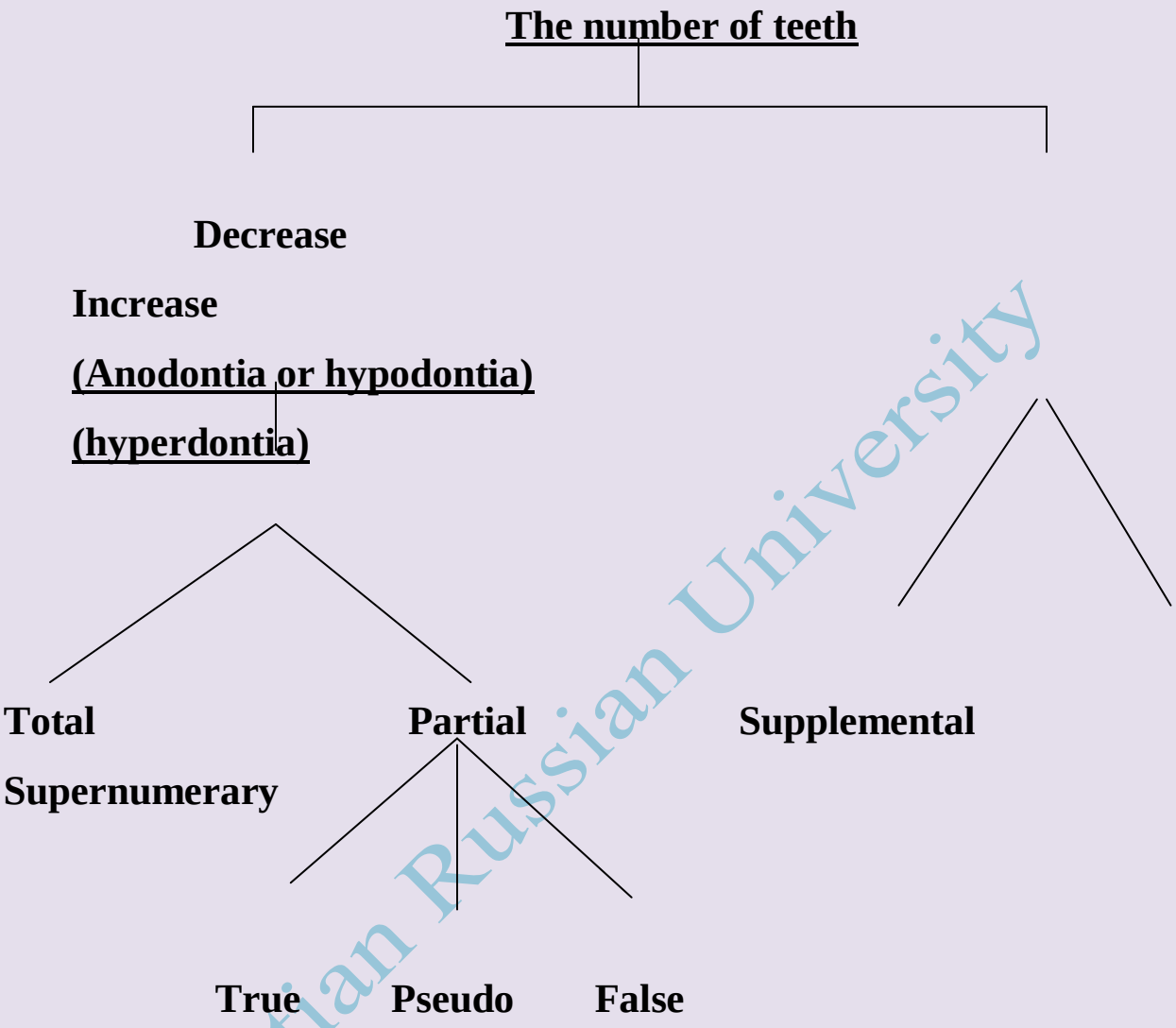
- Initiation stage.
- Proliferation stage.
- Histo and morpho-differentiation stage.
- Apposition stage.

Variation from normality that may affect teeth and their calcified structure include the following:

- Variations in number.
- Variations in size.
- Variations in shape.
- Variations in structure.

I-Variations in number

It occurs due to disturbances of the initiation stage. The variation in number may be either decrease or increase of the normal number of teeth.



1- Decrease in number (anodontia or hypodontia):

A) Total Anodontia:

Total absence of teeth may be:

- Unassociated with other systemic defects.

Or - associated with ectodermal defects as in ***hereditary ectodermal dysplasia (Streeter's syndrome)***: it is a hereditary (sex-linked recessive trait) condition in which the individual is suffering from deficiency in ectodermal structures such as:

-Teeth: total anodontia due to failure of tooth development (true anodontia).

- Skin: thin, dry and shiny.

- Hair: absent or scanty especially scalp, eye lashes and eye brows.

- Brain: mental retardation.

- Glands:

Sweat glands: absent leading to deficient sweating with intolerance to hot weather which is the first symptom of the syndrome.

Sebaceous glands: absent leading to dry skin.

Salivary glands: absent leading to xerostomia (dry skin).

Mucous glands: in nose leading to rhinitis, in pharynx leading to pharyngitis.

B) Partial anodontia (hypodontia):

It may be:

-True: teeth are not present clinically or radiographically due to failure of their development.

- Pseudo: teeth are not present clinically but present in the jaw as confirmed radiographically. This is because of: failure of their eruption due to lack of space ***(impaction)*** or due to lack of force of eruption ***(embedded).***

- False: teeth are not present clinically or radiographically. It is due to teeth extraction or their loss by trauma.

The teeth that are more commonly absent are:

* ***Upper and lower third molars:*** this may be unilateral or bilateral. The cause may be hereditary, racial or due to changing of food habits (soft food makes no need for the third molar which may be rudimentary or absent).

*__Upper lateral incisors:__ this may be unilateral, bilateral or unilateral with pegging of the contra-lateral. The cause may be hereditary (autosomal dominant gene) or due to hypothyrodism. Females are affected more than males.

*__Lower second premolar:__ this may be unilateral or bilateral. The cause may be hereditary or traumatic due to extraction of lower deciduous second molar because of its presence between their roots ***(odontoiatrogenic means*** error caused by the dentist**.**

2) Increase in number (hyperdontia):

It is extra teeth or additional teeth which may be supplemental or supernumerary.

A) **Supplemental teeth:**

They are the extra teeth that resemble the normal adjacent teeth. The most common affected teeth are:

* ***Extra upper lateral incisor:***

This may be due to complete division of enamel organ that may be associated with cleft palate or due to extra tooth germ from the dental lamina.

* ***Extra lower second premolar (third premolar):***

It is due to extra tooth germ from dental lamina.

**** Extra upper and lower third molars (fourth molars):***

It is due to extra tooth germ from the dental lamina. It may be impacted then erupt after extraction of all teeth and using the denture.

B) Suppernumerary teeth:

They are extra teeth not resemble the normal adjacent (conical or peg-shaped teeth).

They are classified according to their sites into:

* ***Mesiodense:***

It is present in the mid line between the upper central incisors. It may be single erupted, double erupt, impacted or inverted.

Its clinical significance:

- It may cause bad aesthetic when erupted or due to separation between the central incisors.
- It may also prevent eruption of one or the two central incisors.
- When it is inverted it may erupt in the floor of the nose.

* ***Paramolar:***

It is a conical shaped small tooth presents at the buccal aspect of upper or lower molars.

It may be separate or fused to the adjacent molar appearing as an extra cusp.

Clinical significance: the retention of food and dental caries formation.

__Distomolar:__

It is peg-shaped and present distal to the third molar.

It may be separate or fused to the third molar and appearing as an extra cusp.

Clinical significance is the retention of food and dental caries formation.

Multiple impacted supplemental and supernumerary teeth are including in the clinical manifestation of a syndrome called ***cleidocranial dysplasia.***

Cleidcranial dysplasia:

It is a hereditary director characterized by deficiency in membranous and cartilaginous bone formation.

It is transmitted through an autosomal dominant gene.

Clinical picture:

- General manifestation:

Clavicle: **-** there is complete or partial absence of one or the two clavicles.

-In case of bilateral complete absence of them the patient can approximate his shoulders together at the midline.

- *Cranium:* -delayed closure of the fontanels leading to broad skull.

- Prominent frontal bone.

- Depressed nasal bridge.

Maxilla: there is underdeveloped, V-shaped, high arched palate and cleft palate.

Mandible: it is of normal size, thus there is a relative prognathism.

- Dental manifestation:

- Normal eruption of deciduous teeth but late or failure of shedding.
- Late or failure of eruption of permanent teeth.
- Radiographically, there is multiple impacted normal, supplemental and supernumerary teeth and multiple dentigerous cysts.
- The crowns of the erupted and unerupted teeth showing gemination or conical-shaped crowns with enamel hypoplasia. While, the roots showing hooked-shaped roots with absence of cellular cementum.

II-Variation in size

This is due to defect occurring during proliferation stage of the tooth development.

It may be:

- Increase in proliferation leading to large-sized teeth (macrodontia).

Or - Decrease in proliferation leading to small-sized teeth (microdontia).

1) Macrodontia:

This condition may be**:**

-True macrodontia:

In which the teeth are actually larger than normal.

It may include single tooth as upper central or lateral incisors as well as upper and lower third molars.

Or it may include unilaterally group of teeth in case of hemifacial hypertrophy.

Or it may be generalized as in case of gigantism.

-Relative macrodontia:

In this case the size of teeth is normal but the jaw is small so the teeth appear large.

2) Microdontia:

This condition may be:

-True microdontia:

In which the teeth are actually smaller than normal.

It may involve single tooth like upper lateral incisor or upper and lower third molars.

Or it may be unilaterally as in case of hemifacial hypotrophy.

Or it may be generalized as in case of dwarfism.

- Relative microdontia:

In which the size of teeth is normal but the jaw is large so the teeth appear small.

III-Variation in shape

It occurs due to disturbance during histo and morpho-differentiation stage.

This variation includes the following conditions:

1) Gemination:

It is defined as ***the partial division of a single tooth germ.***

It may be partially divided into two equal or unequal parts.

The partial division may also be mild or sever.

The geminated tooth has one root and one root canal.

No change in the total number of teeth.

2) Fusion:

It is defined as ***the union between two adjacent tooth germs.***

Complete or incomplete fusion occurs with one root and two root canals.

Number of teeth decrease by one except if fusion occurs between normal tooth and adjacent supernumerary tooth.

3) Concrescence:

It is defined as ***a form of fusion occurs between adjacent molars by cementum only.***

The cause: crowding of teeth or trauma leading to resorption of interseptal bone.

Clinical Significance: fracture may occur during extraction.

4) Dilaceration: it is defined as ***a sharp bend occurs in the crown, between crown and root or along the length of the root.***

The cause: mild trauma.

Pathogenesis: mild trauma to the deciduous teeth, especially the anterior incisors, pushing the developing tooth gems of the permanent teeth in the jaw. This trauma will affect the already calcified hard part of the tooth gem leading to its movement along the direction of trauma, while the still uncalcified part being soft and resilient will absorb the trauma and return to its original poison.

Clinical significance: - Bad aesthetic.

- Difficulty in extraction.
- Difficulty in root canal treatment.

5) Dental manifestations of congenital syphilis:

It is due to acquired infection transmitted from syphilitic pregnant mother to her foetus after the fourth month of intrauterine life.

The causative organism is the treponema pallidum.

The deciduous teeth are not affected because their development occurs before the fourth month of intrauterine life.

So the affected teeth are the permanent central incisor and the first molar.

The central incisor is called Hutchinson' incisor and the first molar may be Moon's molar or Mulberry molar. Their enamel surfaces show enamel hypoplasia (defect in the structure).

A) Hutchinson's incisor:

The affected teeth: the upper permanent central incisors.

The shape: the mesial and distal angles are rounded giving a barrel or crew driver appearance.

B) Moon's molar:

The affected teeth: the first permanent molars.

The shape: the molars have small occlusal surfaces (dome-shaped).

C) Mulberry molar:

The affected teeth: the first permanent molar.

The shape: the occlusal surface shows multiple cuspules.

6) Taurodontism (Bull-like tooth):

It is a developmental condition in which the crown is enlarged on the expense of root.

These teeth have no constricted neck.

The cause: failure of epithelial root sheath of hertwig's to invaginate at the proper horizontal level.

Radiographically: the teeth show large pulp chamber.

According to the level of bifurcation it is classifies into:

*****Hypotaurodontism*** (the mildest form).

*****Mesotaurodontism***

*****Hyper taurodontism*** (the sever form)

Clinical significance: easily extracted.

7) Invaginated odontome:

It is also called ***dense invaginatus.***

It is present at the cingulm area of the upper anterior teeth (palatal pit).

The invagination is lined by enamel, thus radiographically it appears as a tooth within a tooth so it is called ***dense in dent.***

Clinical significance: retention of food leading to dental caries and early pulp exposure.

8) Evaginated odontome:

It is also called ***dense evaginatus.***

It occurs in the occlusal surface of premolars.

It appears as an extra cusp between the buccal and the palatal cusps.

It occurs more common in Caucasian and Mongol peoples.

Clinical significance: fracture during mastication and development of dental caries.

IV Abnormalities of structure of teeth

(Hypoplastic teeth)

It occurs due to disturbance during the apposition stage of tooth development.

This defect may be due to hereditary or acquired causes.

The following table is showing the difference between the structural defects according to its cause:

	Hereditary defects	Acquired defects
Affected structure	Either enamel or dentine	Both enamel and dentine
Affected dentition	Deciduous and permanent	Either deciduous or permanent
Affected teeth	All teeth	Single tooth or group of teeth
Defect orientation	Vertically oriented	Horizontally oriented

First: defects of enamel

1) Hereditary structural defects of enamel

(Amelogenesis Imperfecta)

There are two forms of amelogensis imperfecta:

- Hereditary enamel hypoplasia.
- Hereditary enamel hpocalcifecation.

The following table is showing the difference between the two forms:

	Hereditary enamel Hypolasia	Hereditary enamel hpocalcification
Defect	Quantitative	Qualitative
Matrix	Deficient	Normal

Maturation	Normal	Decreased
Mineralization	Normal	Deficient
Enamel hardness	Normal	Soft
Surface lustre	Translucent	Opaque
Surface texture	Smooth	Rough
Radiographically	Normal radiopacity	Decreased radiopacity (indistinguishable from dentine)

2) Acquired enamel hypoplasia

This structural defect may be due to local factors or systemic factors.

A) Local factors:

- Trauma:

Trauma to deciduous teeth especially anterior teeth may push them in their sockets and their roots affecting the developing tooth germs of the permanent successors. This may lead to horizontally oriented hypoplastic defect running between the calcified enamel and that is not calcified yet.

- Infection:

The periapical infection of deciduous teeth especially molars may reach to the developing tooth germs of the underlying premolars causing hypoplastic defect.

- Irradiation: If the individual is subjected to radiotherapy during the apposion stage of the tooth development, the teeth will suffer from horizontally oriented hypoplastic defects.

N.B. Turner's tooth: it is a single tooth showing hypoplastic defect due to trauma or infection.

B) Systemic factors:

Many systemic causes may have toxic effect on ameloblasts causing hypoplastic defects as the following causes:

- ***Nutritional deficiency:*** especially vitamins A, D, and C as well as minerals like calcium and phosphorous.

- ***Exanthomatous fevers:*** these are the fevers that lead to red rash on the skin e.g. scarlet fever, measles and chicken pox.

- ***Chemicals:*** fluoride and tetracycline.

- ***Rh incompatibility.***

- ***Congenital syphilis.***

- ***Cleidocranial dysplasia.***

- ***Infantile gastro-intestinal disturbances.***

Dental flourosis (mottled enamel):

If the fluoride content of drinking water more than 1ppm, the developing teeth of the individual living in this area will suffer from hypoplastic defects.

This condition will affect both deciduous and permanent teeth as these inviduals born and live in this area during tooth development.

The mottled teeth are less susceptible to dental caries.

Clinical picture: according to the severity of the condition, there are four stages:

Very mild: if less than 25% of the enamel surface has opaque areas.

Mild: if 25-50% of enamel surface has opaque areas.

Moderate: if 100% of the enamel surface shows white opaque areas.

Sever: the enamel surface is defective and showing pits or grooves that stained brown.

Tetracycline pigmentation:

Tetracycline binds to calcifying tissues like developing teeth and bones thus staining them.

The affected teeth exhibit fluorescence under ultraviolet light.

Second: defects of dentine

Hereditary structural defects of dentine

(Dentinogenesis Imperfecta)

It is also called ***brown opalescent dentine.***

Dentinogenesis imperfecta may be associated with other diseases (type I) or associated with osteogenesis imperfecta of bone (type II). While the shell tooth (type III) is a variant of dentinogenesis imperfecta.

Clinical picture

The crown is small, bulbous with constricted neck and has brown opalescent hue.

The roots are short and stunted.

Enamel is easely chipped away from dentine and rapid wearing of the tooth occurs.

Microscopic picture of dentinogenesis imperfecta:

- Normal enamel.
- Flat D.E.J.
- Normal mantel dentine
- The dentinal tubules of the rest of dentine are fewer in number, wider in diameter and more tortuous in course.
- Pulp stones or complete obliteration of the pulp.
- Absence of odontoblastic layer.

Microscopic picture of shell tooth:

- Normal enamel.
- Flat D.E.J.
- Thin layer of normal dentine, then stoppage of further dentine formation.
- Huge pulp.