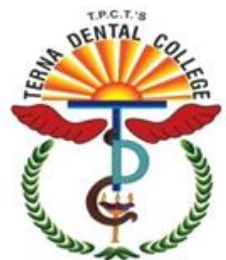


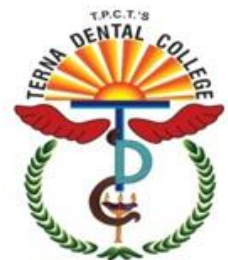


Dental caries 1



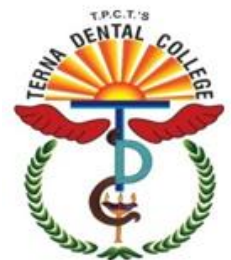
Learning objective

- Having a background of literature in the topic of dental caries is extremely essential for understanding the latest concepts.
- This lecture gives an insight in the traditional theories and key concepts of caries.



Contents

- Definition
- Theories of dental caries
- Keys triad
- Newburn's tetrad



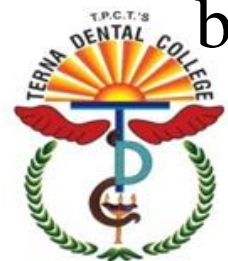
Definition

- **According to Ostrom (1980)**

Process of enamel or dentin dissolution that is caused by microbial action at the tooth surface and is mediated by physiochemical flow of water dissolved ions.

- **According to Glossary of Operative Dentistry terms (1983)**

Dental caries is a process that brings about the progressive demineralization of the inorganic component of the tooth, accompanied by disintegration of the organic portion.



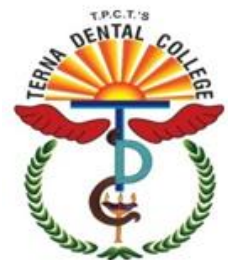
The logo of Terna Dental College is a large, semi-transparent watermark in the background. It features a central caduceus (a staff with two snakes entwined around it and wings at the top) surrounded by a laurel wreath. Above the caduceus is a sunburst with rays in shades of yellow and orange. The text "T.P.C.T.'S" is at the top, "TERNA DENTAL COLLEGE" is written in a semi-circle around the top, and "TERNA" is written vertically on the left side.

- **According to Ernest Newburn (1989)**

Dental caries is defined as a pathological process of localized destruction of tooth tissues by micro - organisms.

- **According to Hume (1993)**

Caries is essentially a progressive loss by acid dissolution of the apatite component of the enamel or the cementum then dentin.



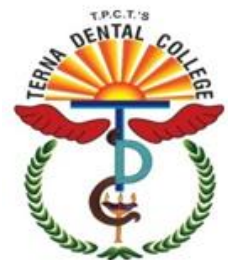


- **According to Shafer (1993)**

It is defined as an irreversible microbial disease of the calcified tissues of the teeth, characterized by demineralization of the inorganic portion and destruction of the organic substance of the tooth, often leading to cavitation.

- **According to G. Nettleman (1998)**

Dental caries is the disease produced by metabolic end products of certain micro organisms that results in dissolution of inorganic components of enamel, dentin and cementum and degradation of their organic structure.



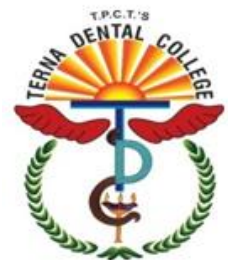


- **According to Sturdevant (2002)**

Dental caries is defined as an infectious microbial disease of the teeth that results in localized dissolution and destruction of the calcified tissues.

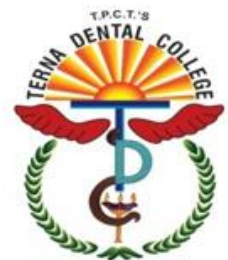
- **According to Frejerskov (2004)**

Dental caries is a complex disease caused by an imbalance in the physiologic equilibrium between tooth mineral and bio film fluid.



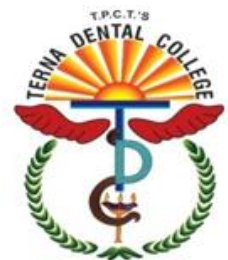
• According to World Health Organization (2005)

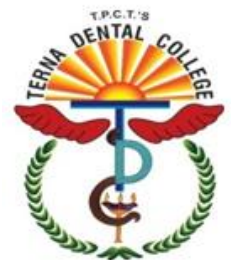
Localized post eruption, pathologic process of external origin involving softening of hard tooth tissue and proceeding to the formation of a cavity.



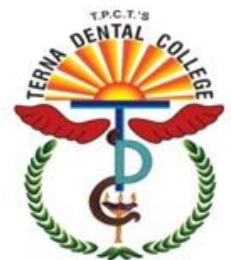
• According to D.C.N.A (2010)

Dental caries is the localized destruction of susceptible dental hard tissue by acidic by-products from bacterial fermentation of dietary carbohydrates. Thus, it is a bacterial driven, generally chronic, site-specific, multifactorial, dynamic disease process that results from the imbalance in the physiologic equilibrium between the tooth mineral and the plaque fluid; that is, when the pH drop results in net mineral loss over time. The infectious disease process can be arrested at any point in time.



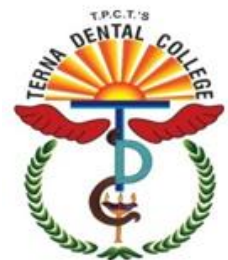


- A forerunner to this theory may have been the observation that internal resorption occurs in some teeth or from the presence of deep undermining carious lesions but with pin point surface involvement of a pit or fissure.

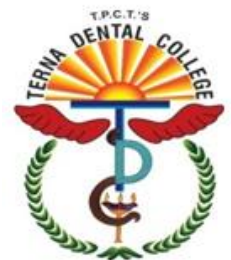


Chemical theory

- In the 17th and 18th century, emerged a concept that teeth are destroyed by acids formed in the oral cavity.
- The acids implicated were inorganic.
- Robertson in 1835 proposed that dental decay was caused by acid formed by fermentation of food particles around the tooth.

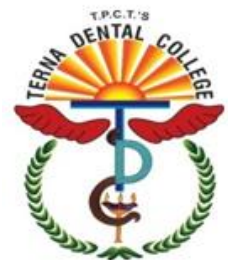


- Fermentation was at this time considered to be a strictly non-vital process.
- Microorganisms were involved was not, as yet recognized

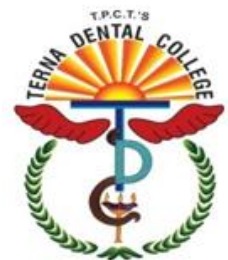


Parasitic theory

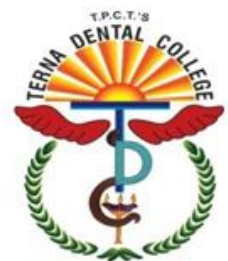
- Long before the demonstration of germ theory of disease, the possibility of micro organisms can have toxic and destructive effects on the tissue was postulated.(Dubos,1954)
- These postulations spelled the end of the vital theory and gave rise to the idea that chemicals destroy the teeth.



- Antoni van Leeuwenhoek (1632-1723), indicated that microorganisms were associated with the carious process.
- Erdl (1843) described filamentous parasites in the membrane removed from teeth.
- Ficinus (1847), observed filamentous organisms in the enamel cuticle (surface protein membrane of teeth) and in carious lesions.

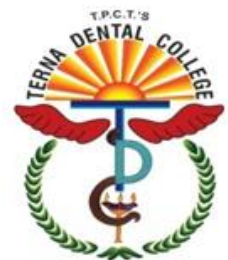


- Dental caries was thought to develop as a result of the infiltration and decomposition of enamel cuticle, the interprismatic substance of enamel and finally dentin.
- Ficinus may have been the first to recognize the presence of organic matrix in the enamel.
- An explanation of the mechanism by which micro organisms caused decay was not attempted until later.

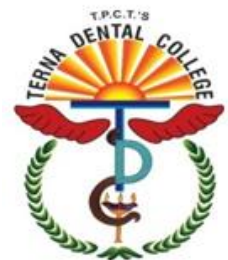


Chemoparasitic theory

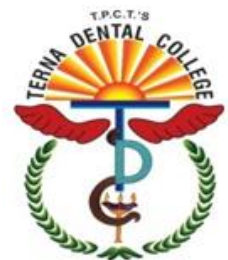
- In 1881, Dr. Willoughby D. Miller published his chemoparasitic theory of dental caries.
- According to this theory, microorganisms metabolize fermentable carbohydrates and acids are produced. These acids then breakdown or demineralize tooth enamel, the first step in dental caries.



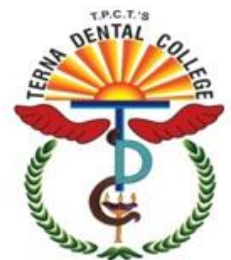
- Miller was able to assign to oral microorganisms the role of acid formation and thus assigned a chemical role to flora which is the basis of his chemoparasitic theory of dental caries.
- The microorganisms of the mouth, by secretion of enzymes or by their own metabolism degrade the fermentable carbohydrate food material so as to form acids. The chief acids formed are namely lactic, butyric, acetic, formic, succinic and other acids.



- Carbohydrate food material lodged between and on surfaces of teeth is the source of the acid, thus the enamel is destroyed by the acid of fermentation and the disintegrated enamel is subsequently mechanically removed by forces of mastication.
- After penetration of enamel, the dissolution of dentin is brought about in the same manner with the organisms penetrating along the dentinal tubules.



- The final breakdown of dentin results from the secretion of proteolytic enzymes that digest the organic part of dentin and form a cavity.

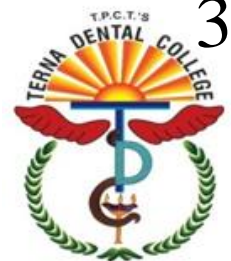




- **Significance of this theory**

- He assigned an essential role to 3 factors in carious process-

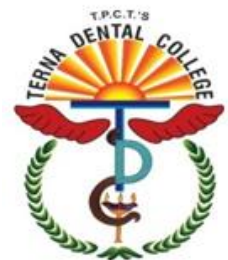
1. The oral microorganisms in acid production and in proteolysis.
2. The carbohydrate substrate which microorganisms fermented
3. The acid which causes dissolution of tooth minerals





- **Limitations of this theory**

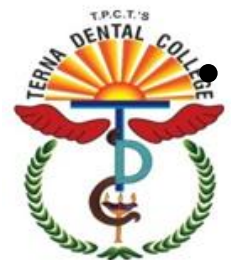
- It was unable to explain the predilection of specific sites on a tooth to dental caries.
- The initiation of caries on smooth surfaces was not accounted for by this theory.
- The concept of dental plaque adhering to the teeth and serving to localize bacterial enzymatic activity was not proposed until 1897 by Williams and 1898 by Black.



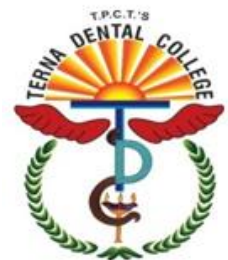
• Miller worked with mixed cultures of saliva and with techniques that did not attempt to ascertain types of organisms present.

• Miller believed that dental caries was caused by multiple species of bacteria.

Miller's theory does not explain why some populations are caries free.

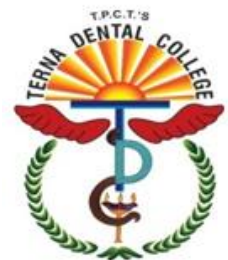


- The phenomenon of arrested caries is not explained by this theory.
- Miller believed that in some systemic conditions the inorganic salts within the tooth could be withdrawn and that the organic inorganic bonds would be weakened.
- He did not produce any experimental evidence that the adult tooth is subject to such systemic conditions

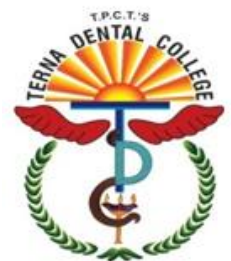


Proteolytic theory

- Proposed by Gottlieb (1947) Frisbee and Nuckolls (1947).
- The surface coverings found on the tooth, in grooves and pits, are organic in nature; also, enamel contains small but significant amounts of organic material
- These observations and the fact that carious lesions are characterized histologically by pigmentation, a phenomenon that was interpreted, without evidence, as being indicative of proteolysis, led to the development of the proteolytic theory.



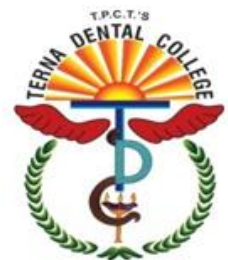
- Gottlieb proposed that micro organisms invade the organic pathways of enamel and initiate caries by proteolytic action.
- Subsequently the inorganic salts are dissolved by acidogenic bacteria.
- Pincus (1950) maintained that the initial process in dental caries was the proteolytic breakdown of dental cuticle, the organic membrane found on all teeth.



The background features a large, semi-transparent watermark of the Terna Dental College logo. It consists of a central emblem with a sunburst at the top, a caduceus in the middle, and a laurel wreath at the bottom. The text 'T.P.C.T.'S' is at the top, and 'TERNA DENTAL COLLEGE' is written in a semi-circle around the emblem.

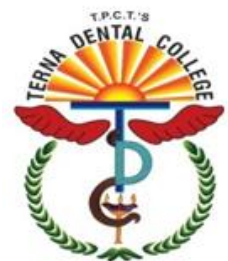
- **Limitations of the theory**

- To date, nobody has under physiological conditions, successfully demonstrated loss of enamel tissue through proteolytic activity.
- Enamel is a highly structured tissue and the accessibility of organic material to enzymatic action before decalcification is restricted.
- Enamel can be dissolved under physiological conditions only by demineralization with acids, chelating or complexing agents.

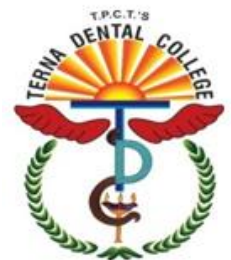


Proteolytic chelation theory

- This theory proposed by Schatz et al (1955) implies a simultaneous microbial degradation of the organic components (proteolysis) and the dissolution of the minerals of the tooth by the process of chelation.
- According to the proteolytic chelation theory dental caries results from initial bacterial and enzymatic proteolytic action on the organic matter of enamel without preliminary demineralization.



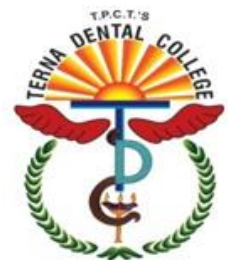
- Such action, the theory suggests produces an initial carious and a release of variety of complexing agents such as amino acids, polyphosphates and organic acids. The complexing agents then dissolve the crystalline apatite.





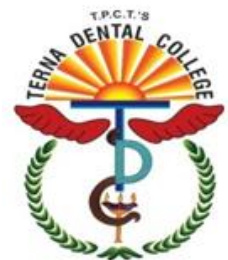
• **Limitations of the theory**

- Less than one percent of mature enamel is organic in nature and the suggestion that this material upon degradation can give rise to a significant concentration of chelator sufficient to dissolve upto 96% mineral matter has no experimental support.
- While proteolysis chelation is an important biological phenomenon, its primary role in the etiology of the dental caries has not been corroborated.



Sulfatase theory

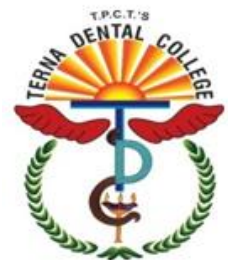
- It was given by Pincus in 1950.
- According to this theory, the bacterial sulfatase hydrolyzes the mucoitinsulfate of the enamel and the chondroitin sulfate of the dentin producing sulphuric acid that, in turn, causes decalcification of dental tissues.





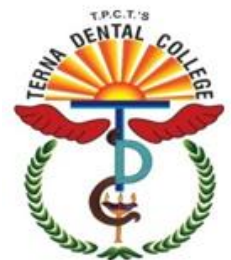
- **Limitations of the theory**

- The concentration of sulfated polysaccharides in enamel is very small and not readily accessible as a substrate for enzymatic degradation.
- This is a highly unlikely hypothesis for the degradation of tooth enamel.



Complexing and phosphorylation theory

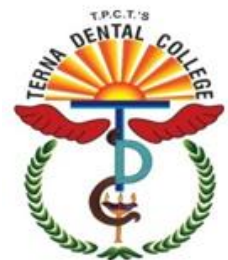
- It can be readily demonstrated that uptake of phosphate by plaque bacteria occurs during aerobic and anaerobic glycolysis and the synthesis of polyphosphates.
- According to this theory, the high bacterial utilization of phosphate in plaque causes a local disturbance in the phosphate equilibrium in the plaque and the tooth enamel resulting in loss of inorganic phosphate from enamel. Soluble calcium- complexing compounds produced by bacteria cause further tooth disintegration.





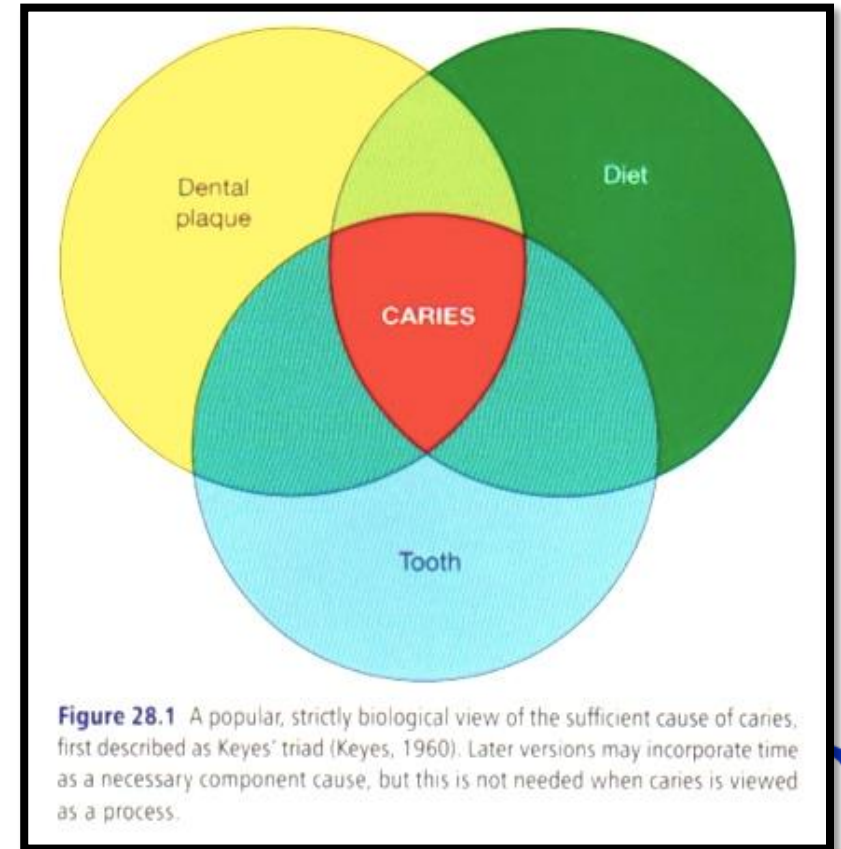
- **Limitations of this theory**

- Saliva is an abundant source of inorganic phosphate for bacterial utilization.
- Hence it is less likely that depletion of phosphate in plaque by oral microbial metabolism results in phosphate withdrawal from enamel



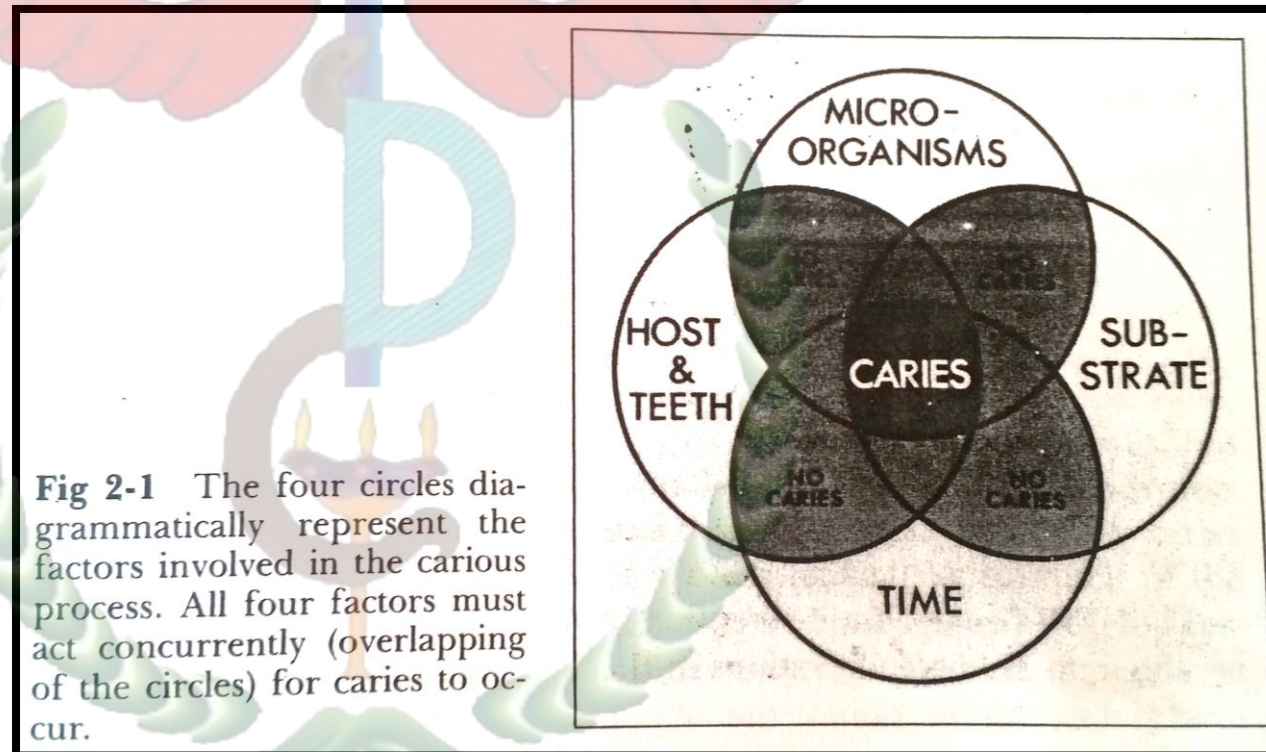
Keys triad

- Dental caries is a multifactorial disease in which there is interplay of **3 principal factors: (Keys 1960)**
 1. The host (primarily saliva and the tooth)
 2. The dental plaque
 3. The substrate or diet



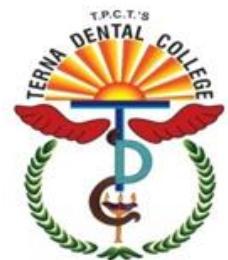
Newburn's tetrad

- In addition, a **fourth factor** i.e **Time** must be considered in any discussion of the etiology of dental caries. (**Newburn, 1982**)
- Diagrammatically these factors can be portrayed as four overlapping circles.



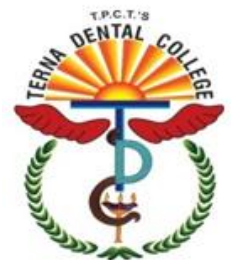
Conclusion

- The concept of dental caries stood the test of time and has undergone modifications with the advancements in research techniques.
- However, the ancient concepts still holds true in a different form.



Take home message

- The concept of dental caries should be understood well to understand the clinical representation of the disease and to treat it accordingly.



SAQ's and LAQ's

- Saq

1. Define dental caries
2. Chemoparasitic theory
3. Key's triad
4. Newburn's tetrad

- Laq

1. Define dental caries. Write a note on theories of dental caries.



