

DENTAL ERUPTION AND ORAL PATHOLOGY AMONG THE GALLONG

By

DHRUBA KUMAR LIMBU
DEPARTMENT OF ANTHROPOLOGY
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Phone 1

Grams 1 NEHU

North - Eastern Hill University

Mayurbhanj Complex

Nongthymmai, Shillong - 793014 (Meghalaya)

.K. Pathak
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ment of Anthropology

CERTIFICATE

Certified that the subject matter of this dissertation is the record of work done by **D.K. Limbu**, that the contents of this dissertation did not form a basis of any previous degree to him or to the best of my knowledge to anybody else, and the dissertation had not been submitted by him for research degree in any other University.

R.K. Pathak

(**Dr. R.K. Pathak**)
Supervisor

Shillong,
30th November, 1990

Department of Anthropology
North Eastern Hill University

November 30, 1990

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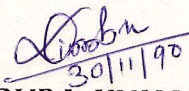
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Department of Anthropology
North-Eastern Hill University

November 30, 1990


30/11/90
DHRUBA KUMAR LIMBU

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Chapter I

INTRODUCTION

Dental anthropology is a specialised field of Physical Anthropology under the broad discipline of anthropology which is concerned with the study of human teeth - one of the anatomical systems of man.

The primary aim of undertaking research works in physical anthropology and human population genetics has been to expound the nature of biological variations in different human populations and the meaning of these differences in the understanding of the ongoing evolutionary process. The systems used have been varying from time to time, and among the other systems regularly studied in this context, human dentition is of special interest and occupies important place. The special interest evinced on dentition may be due to its diachronic capability, to know about our species and racial origins, ease of direct comparison with living and also past populations facilitating of a much greater time depth in micro and macro evolutionary investigations and number of synchronic purposes. Teeth being the hardest and most durable materials of all parts of the body due to the presence of enamel and dentine in them preserve well and hence account for a large proportion of the human and pre-human fossil remains available for study. The environment has limited influence on the teeth which are highly genetic in nature as revealed by many a study postulating modes of inheritance for different dental traits (Kraus, 1951; Turner, 1967). They are the least biased to subjectivity unlike other anthroposcopic traits regularly studied and hence greatly help in the comparison and classification of populations as other biogenetic markers like blood groups, red cell enzymes,

dermatoglyphics, etc. do. The different dental aspects of study which attract the attention of human biologists are crown morphology, metrics, health, evolution, growth, genetics, usage, forensic and ethnographic treatment, all of which can be used as research tools and areas of academic studies.

It is well known that a series of variables such as sex, race, heredity, socio-economic level, and some aspects of the intrauterine and postnatal environment influence the sequence and timing of tooth emergence. The ever increasing volume of reports on the time of tooth emergence for human, primate, and mammalian groups is broadening our knowledge of the diversity in the timing of appearance of teeth in the oral cavity. The information is valuable in assessing the diversity seen between populations.

The dental status of an individual at a particular age, especially in the younger age groups, provides an index of physiological maturity for the children. The chronology of tooth emergence has often been used in the medico-legal cases for the estimation of age.

Dentition is one of the most important anatomical systems of the human body. There are definite genetic factors that influence the entire dentition, those that affect only certain groups of teeth, and those that act on single tooth. The large genetic component and high heritability of dentition have been demonstrated by a number of genetic studies which facilitated the postulation of the modes of inheritance for various dental

traits.

Dental age like skeletal age and secondary sex character age is useful for the assessment of biological age, the significance of which has been greatly recognised in the diagnosis and treatment of children with growth disturbances. It can be estimated from data on tooth eruption in such a situations where it is highly difficult to estimate the chronological age on the basis of historical events. A proper estimation of dental age can be accomplished only by reference to standards established on the population, of which the subject is a member, living in same environmental conditions.

It has to be admitted that teeth are not only good indicators of age of the juvenile fossil ancestors of man but they also help in quick and easy identification of skeletal remains, cadavers, or amnesia victims. The standards obtained from the studies on tooth eruption pattern are quite useful to the orthodontist in proper and planned scheduling of maturation in comparison to other populations, and to forensic anthropologist as a criterion of age.

The age and order of eruption of deciduous and permanent teeth show as much marked variation between one individual and the other as among the different racial groups within same region. If a larger sample is studied possibly from a racial group, one can establish either a trend,

a constant, or a distribution within that sample of sufficient reliability just to justify the application to that group as a whole so that it could be distinguished from other populations.

History and Evolution of Subject

Study of dental anthropology began in the eighties of the 18th century when investigations on physical anthropology centered mainly round the analysis of the morphology of skeletons and teeth, though as a subject of academic research, its importance was not recognised until 1900. The root of the dental anthropology lay in the seventies of the 19th century as shown by a number of investigations, when the subject got its breakthrough for the first time.

The analysis of dentition has been long considered an important aspect of anthropological research on the biology of extinct and extant populations. In 1927, Krogman published the first comprehensive review of research on primate dentition. This 100 page treatise, comprising an entire issue of the Journal of Dental Research, should be considered a cornerstone in the field. It is obvious that to Krogman (1927), dental anthropology included the study of dental growth, theories on dental origin, primate dentition and population variation.

Following Krogman's work, research on dental anthropology proliferated in numerous anthropological and dental research journals. In addition,

there were a number of special journal issues, dissertations, monographs, and books developed to this subject (e.g., Moorrees, 1957; Brothwell, 1963; Wolpoff, 1971; Kurten, 1982; Reddy, 1985). In the American Journal of Physical Anthropology alone, annual report of the editorial notes that dental papers comprised about 11% of the total manuscripts submitted in 1985 and 1986. This is not a new trend, but rather a continuation of interest that has existed since the early days of the journal.

While dental anthropology was very much alive on the individual research level, there was no organized forum in which to communicate with others in the field to facilitate the exchange of ideas. The Dental Anthropological Association (DAA) was officially created in 1986 during the American Association of Physical Anthropologists (AAPA) meeting in Albuquerque, New Mexico, and established the 'Dental Anthropology Newsletter' as its official publications. Since its inception, the DAA has sponsored symposia and scientific sessions where it exemplifies the diversity in dental anthropology, including interest in recent and archaeological populations as well as variation in methodological approaches and scientific results.

Dental Eruption

The process by which the crown of the developing tooth passes through its interosseous surroundings and is maintained in normal occlusion

within the oral cavity is known as tooth eruption. Tooth eruption is generally defined as the time when any part of the crown of the tooth has emerged through the gingival surface. In the words of Rainbow (1973), "... dental maturation is a continuum, comparable to skeletal maturation. One may calculate dental ages through the entire growth period, from foetal life to adolescence, by assessing stages of tooth formation, crown calcification, root development and eruption status from appropriate roetgenograms (oblique jaw views or pantomograms) and comparing the developmental status of each tooth with appropriate norms".

The age and order of eruption of deciduous and permanent teeth show as much marked variation between one individual and the other as among the different racial groups within the same region or outside. As such Hellman (1923), six decades ago, remarked: "The arrival of a comet which makes its appearance once in many years, can be accurately calculated to a small fraction in time, but notwithstanding the inestimably greater frequency with which the event of eruption occurs, the appearance of a tooth defines accurate forecast", which is perhaps valid even today. Therefore, one can establish a trend or a constant if a larger sample is studied possibly from a racial group.

Unlike in permanent teeth eruption times there is no significant difference in the eruption times of deciduous teeth in children of same physical health in many ethnic groups as well as between males and females,

though the role of genetic factors has been shown by twin studies.

After the crown and part of the root are formed, the tooth penetrates the mucous membrane and makes its entry into the mouth. Further formation of root is supposed to be an active factor in pushing the crown toward its final position in the mouth. Eruption of the tooth is said to be completed when most of the crown is in evidence and when it has made contact with its antagonists in the opposing jaw. Eruption may and usually does continue after this; i.e. more of the crown may become exposed and the tooth may move farther occlusally to accommodate itself to new conditions.

The Deciduous Dentition

Calcification of the deciduous teeth begins about the fourth month of the foetal life; near the end of the six month, all the deciduous teeth have begun to develop. Normally, at birth no teeth are visible in the mouth, occasionally, however, infants are born with erupted mandibular incisors. Such prematurely erupted teeth are usually lost soon after birth because of the incomplete development of the root attachment (Wheeler, 1988).

The deciduous mandibular central incisors appeared in the mouth at the age of approximately 6 months. They are followed a month or so later by the maxillary central incisors. About two months elapse before

the maxillary lateral incisors appear. The mandibular lateral incisors usually emerge a little earlier than maxillary laterals; in fact, to illustrate the variance in sequence in individuals, babies are often displaying four mandibular incisors and no maxillary teeth at all. However, the general rule to be kept in mind is that individual mandibular teeth usually precede the maxillary teeth in the process of eruption and the teeth in both jaws erupt in pairs, one right and one left.

Man has two sets of teeth; the first set of teeth is called primary set or milk teeth. These are 20 in number, i.e. 10 teeth in each jaw. The calcification of these teeth starts when the embryo is 16 weeks old. The development of the teeth continue during the period of pregnancy; hence it is important that the mother has proper nutrition in the form of adequate amount of calcium, vitamin D, phosphorus, etc. for the formation of healthy teeth and good jaws. The milk teeth start appearing in the mouth of the baby approximately by the age of six months and are complete by two and half to three years of age.

The usual order of appearance of the deciduous teeth in the mouth is as follows :

1. Central incisors
2. Lateral incisors
3. First molars
4. Canines
5. Second molars

A common impression, which is still widespread, is that the deciduous teeth are not to be taken seriously, since they will be lost at an early age in the process of making way for the permanent teeth. All the deciduous teeth may be in use from the age of 2 until the age of 5 years, or 7 years in some cases. Some of the deciduous teeth are in use from 6 months until 12 years of age, or $11\frac{1}{2}$ years in all. The actual situation is, that these teeth are in use, contributing to the health and well-being of the individual, during the first years of greatest development, physically and mentally.

The premature loss of primary teeth, retention of primary teeth, congenital absence of teeth, dental anomalies, and insufficient space are considered important factors in the initiation and development of an abnormal occlusion. The premature loss of primary teeth from dental neglect is likely to cause a loss of arch length with a consequent tendency for crowding of the permanent dentition.

The Permanent Dentition

The permanent set of teeth which are 32 in number are larger in size and continue to function throughout the life span of an individual if well cared. These teeth start eruption, generally, from the age of $5\frac{1}{2}$ to 6 years and have fully erupted and come into occlusion by the age of 21 years or so. All the deciduous teeth are replaced by the permanent

teeth during the age of 6 to 12 years. The care of deciduous teeth is equally important as care of the permanent teeth because they not only function in the early childhood but they also act as guides to permanent (development) successors as well as help in proper development of the jaws. The diseases which affect the deciduous teeth could also be passed on to the permanent teeth.

The transition to the permanent dentition begins with the emergence and eruption of the first permanent molars, shedding of the deciduous incisors, and emergence and eruption of the permanent incisors. After the shedding of the deciduous canines and molars, emergence and eruption of the permanent canines and premolars, and emergence and eruption of the second permanent dentition is completed except for the third molars. This process requires about 20 years to complete. The permanent or succedaneous teeth replace the exfoliated deciduous teeth in a sequence of eruption that exhibit great variety. The number of teeth in adults, including third molars when present, is 32.

The permanent dental formula in humans is :

$$I \frac{2}{2} \quad C \frac{1}{1} \quad P \frac{2}{2} \quad M \frac{3}{3} = 16$$

Premolars have now been added to the formula, two maxillary and two mandibular.

In a clinical notation system for the permanent dentition, the maxillary teeth are numbered from 1 to 16, beginning with the right third molar. Beginning with the mandibular left third molar, the teeth are number 17 through 32. Thus, the right maxillary first molar is designated as 3, the Maxillary left central incisor as 9, and the mandibular right first molar as 30. The entire dentition is designated by the notation :

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
32	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17

The usual order in which the permanent teeth appear is as follows:

1. First molars
2. Mandibular Central and Lateral Incisors
3. Maxillary Central Incisors
4. Maxillary Lateral Incisors
5. Mandibular Canines
6. First Premolars
7. Second Premolars
8. Maxillary Canines
9. Second Molars
10. Third Molars.

It has been suggested that a certain sequence or eruption of the teeth

is considered to be favourable to the development of a normal occlusion.

Oral Pathology

Dental caries or tooth decay and pyorrhea or periodontal diseases are the commonest diseases of the mouth. The former being the disease of the tooth proper and the latter that of the supporting structures of the tooth. Both these disease have afflicted not only the human races all the world over since pre-historic times up-to-date but also the non-human primates and lower animals.

Dental Caries

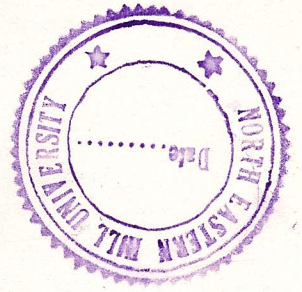
Dental caries is a pathological condition of the teeth resulting in the decalcification of the dentine or enamel and the disintegration of the remaining organic material often leading to the loss of the teeth and occurs in association with other conditions such as periodontal disease, which causes recession of the alveolar bone resulting in loosening of the teeth and their subsequent loss; dental abcess, which is a cavity of pus within the alveolus near the root apex; dental enamel hypoplasia, which is a developmental enamel defect in the deciduous and permanent teeth seen as transverse lines, pits, and grooves on the enamel surface; ante-mortem or tooth loss; and attrition, which is the gradual wearing away of the hard parts of the teeth.

The IDF (International Dental Federation) Commission on Classification and Statistics for Oral Conditions (COSTOC) in its recommendation to the World Health Organisation, on the classification of epidemiologic studies of dental caries and definitions of related terms (1975), defined dental caries "as a localised, pathologic process of bacterial origin, that results in the demineralization of the hard tooth structures and progression to cavitation. Caries, being a disease process, starts with a microscopic lesion and eventually progresses into a macroscopic cavity. The term 'caries' designates 'decay of animal tissue'. Hence, it is necessary to specify tooth decay as dental caries ...". It is characterised by the molecular decay of bone softening the enamel and dentine in which it becomes thin and dark and usually breaks down with the formation of pus. It is generally held that there are micro-organisms of the type Lactobacillus Acidophilus odontolyticus in the mouth which are cariogenic in nature and produce acids by acting on food debris lodging around the teeth. These acids largely dissolve the hard tissues of the teeth leading to caries. There are different theories for explaining the etiology of dental caries. German scientists named Leber and Rottenstein in 1867, and Underwood and Mills in 1881, propounded the Acidogenic theory based on the experiments conducted on animals. Experiments confirmed this fact, because the existence of micro-organisms in man's mouth is necessary to ensure the physiological functions in the body, although it is still unknown which type of micro-

organism or virus is responsible for the disease as many kinds of them produce acids under varying circumstances ranging from neglect of oral hygiene to sugar containing food debris. Miller (1883) through his classic work made the explanation of the etiology of dental caries widely acceptable which according to him, was known as "Chemico-parasitic theory". There are other theories too such as the Proteolytic theory of Boedecker and Gottlieb, and also the Proteolysis-Chelation theory of Isenberg, Martin, Shatz and others put forth in 1950s on the etiology and pathogenesis of caries, which did not convince the scientific world.

James (1979) lists a number of contributory factors causing tooth decay which he divides into two broad categories namely intra-oral and extra-oral causes. Included in the intra-oral causes are the dental plaque consisting of food and bacteria in a creamish film sticking to the teeth; anatomy of the tooth - shape, form and structure; position of the teeth; dental appliances and restoration; and lack of salivary flow. The extra-oral causes are hereditary; high sugar intake, nutritonal deficiency in calcium, phosphorus, flurides, vitamins A, C and D and proteins, soft foods, and bottle feeding. Leus (1981), however, reduces them only to four to five well known factors which cause dental caries; low fluoride levels in drinking water, food products containing large quantitives of sugar, bad childhood health in general, inadequate quantitites of saliva and disturbance of its optimal composition. Hereditary predisposition of dental tissue to caries

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appears to be another factor. The most important factors that contribute to the disease are consumption of food products with increased quantities of sugar and fluoride-lacking drinking water. When the disease acquires a high degree of severity, the affected individual finds it difficult to eat and swallow and at times resulting in speech problems and fever.

First of all, there is a loss of polish and translucency of the tooth surface, i.e. it changes the colour from white to brown or black. The area becomes soft and porous and the food starts getting lodged into it. The person becomes sensitive to cold and hot drinks and sweet and sour things. It gives mild to severe toothache depending upon the nearness and involvement of the pulp. The tooth becomes tender and is not able to chew food with it. In Sushruta Samhita the symptoms are described thus: "The tooth becomes loose and perforated by black holes accompanied by a copious flow of saliva. The appearances of an extremely diffused smell with a sudden aggration of the accompanying pain without any apparent cause is also one of its specific features". Once the pulp is involved, it becomes a passage for the oral micro-organisms to travel into the bone, smelling appears into that area and other complications of inflammation follow.

Caries of the teeth could be acute or rampant when the susceptibility is very high. Almost all surfaces are affected. Even the very immune areas, viz. the cervical and proximal surfaces of mandibular incisors are

involved. The other type is chronic or slow growing. It may involve one tooth or a group of teeth at the same time. There is another type called arrested, where further progress of caries does not take place because the area had become self-clean sample and secondary dentin has formed.

It has been labelled as a disease of the Western countries but this is not true. It is very much prevalent in our country. Different surveys conducted in this country reveal that the incidence is on the increase in the developing countries. More and more children are affected by it. It is second important disease next to pyorrhea for loss of teeth in Indians.

Tylor and Marshal Day observed in 1939 a low incidence of caries in Kangra Valley. Marshal Day and Tandon (1940) from another group of children in Punjab recorded that caries was much less than in American children.

Shourie (1941) made a comprehensive survey of children from various parts of India. He reported that 44.5% of children were free from caries which was considered to be much higher than that recorded in children in England and U.S.A. The incidence of caries in deciduous teeth was higher in girls than in boys. Urban children in all age groups showed more caries than the rural children. Thereafter, a number of surveys carried out by Vacher (1952), Mangi and Jalili (1961) showed the caries incidence to be on the increase.

Periodontal Diseases

Periodontal disease is the most common oral health problem of man

and also a major problem in modern dental practice. Paleopathological studies indicate that man has been subject to periodontal disease since prehistoric times, and our earliest historical records reveal an awareness of periodontal disease and the need for treating it.

Periodontal disease was the commonest of all diseases of which there was evidence in the embalmed bodies of the Egyptians of 4000 years ago. Oral hygiene was practised by the Sumerians of 3000 B.C., and elaborately decorated golden toothpicks found in the excavations at Ur in Mesopotamia suggest an interest in cleanliness of the mouth. In the oldest known Chinese medical work, written about 2500 B.C. by Hwang Fi, oral disease is divided into three types, as follows : 1) Fong Ya, or inflammatory conditions; 2) Ya Kon, or diseases of the soft investing tissues of the teeth; 3) Chong Ya, or dental caries. Gingival inflammations, periodontal abscesses, and gingival ulcerations are described in accurate detail. One gingival condition is described as follows: "The gingivae are pale or violet red, hard and lumpy, sometimes bleeding; the toothache is continuous". Herbal remedies, "Zn-hine-tong", are mentioned for the treatment for these conditions. The Chinese were among the earliest people to use the "chew stick" as a toothpick and toothbrush to clean the teeth and massage the gingival tissues.

Among the ancient Greeks, Hippocrates of Cos (460-335 B.C.) was the father of modern medicine, the first to institute a systematic exami-

nation of the patients pulse, temperature, respiration, excreta, sputum, and pains. He discussed the function and eruption of the teeth and also the etiology of periodontal disease.

Among the Romans, Aulus Cornelius Celsus (first century A.D.) referred to diseases which affect the soft parts of the mouth and their treatment as follows : "If the gums separate from the teeth, it is beneficial to chew unripe pears and apples and keep their juices in the mouth". He described looseness of the teeth caused by the weakness of their roots or by flaccidity of the gums and noted that in these cases it is necessary to touch the gums lightly with a red hot iron and then smear them with honey. The Romans were very interested in oral hygiene.

Rhazes (850-923), an Arabian of the Middle Ages, recommended opium, oil of roses, and honey in the treatment of periodontal disease. To strengthen loosened teeth he recommended astringent mouth washes and dentifrice powders. He described a procedure of scarification of the gingiva, and strong couterirritants in the treatment of disease of the gums.

In the fifteenth century, Valescus of Montpellier (1382-1417) stated that in order to treat disease of the gums, tartar must be removed little by little either with iron instruments or with dentifrices. In the fourteenth century and fifteenth centuries references is also made to white wine, roasted salt, and aromatic substances as adjuncts in periodontal therapy.

With the beginning of the eighteenth century dentistry developed the early signs of scientific curiosity which were the precursors of present day research disciplines.

Pierre Fauchard (1678-1761), the father of modern dentistry, in the first and second editions of his epochal treatise "Le Chirurgien Dentiste" discussed many aspects of the subject of periodontology. He described chronic periodontal disease as a "kind of scurvy" which attacked the gums, the alveoli, and the teeth.

With the beginning of twentieth century there developed a prolific group of clinicians and scientists throughout the world with a major interest in the periodontal field.

The periodontium is the investing and supporting tissues of the tooth, and consists of the periodontal ligament, the gingiva, cementum, and alveolar bone. The cementum is considered a part of the periodontium because, with the bone, it serves as the support for the fibers of the periodontal ligament. The periodontium is subject to morphologic functional variations as well as changes with age.

Pyorrhea or periodontal disease unlike dental caries is the disease of the periodontium or the supporting structures of the teeth namely the gum, alveolar bone, periodical membrane and cementum. Inflammation and dystrophy are the two ways by which the disease of the periodontium

occurs. Inflammation of the gums or gingiva results in gingivitis manifested as change in colour, enlargement, bleeding, puffiness, friability, ulceration or sloughing. Gingivitis is the first stage of the periodontal disease when the gums are affected. Accumulation of tartar (calculus), the scaly yellowish or brownish hard chalk-like substance that forms at the gums around the teeth, is the most common cause of the gingivitis, others being the bacterial infection, acute necrotizing ulcerative gingivities, mouth-breathing habit, axis and contour of the teeth, faulty dental fillings, presence of food particles between the teeth, abrasions, cuts, fingernail and fishbone injuries, puberty and pregnancy periods, skin diseases, syphilis, tuberculosis, leukemia or blood cancer, vitamin C deficiency etc. Periodontal disease or periodontitis is the extension of gingivitis when inflammatory conditions spread to deeper structures leading to characterized by degenerative factors affect the gums and periodontium resulting in the fall of certain teeth. Thus periodontal disease, which is also widespread a disease as dental caries, leads to tooth loss, bad smell, tooth spacing, deterioration in the general bodily health, etc.

The term periodontal disease has received different meanings and is used rather ambiguously. It is used in a general sense to encompass all diseases of the periodontium in much the same way as are terms such as liver disease and kidney disease. It may be considered synonymous with periodontopathia, although this term is not in current use.

Periodontal diseases may be of different types. The most common by far is also called periodontal disease; in old text-books and papers it was called pyorrhea, periodontoclasia, periclasia, etc. This disease is initiated by plaque accumulation in the gingivo-dental area and is basically inflammatory in character. Initially it is confined to the gingiva and is termed gingival disease, later supporting structures become involved and the disease receives the name of periodontal disease. The term chronic destructive periodontal disease, which very accurately describes the condition, was used.

Periodontal disease	Periodontal disease	Chronic destructive periodontal disease	Periodontitis
(Synonym not currently used: periodontopathia)	Other disease of the periodontium	Gingival disease	Trauma from occlusion
			Periodontal atrophy

The above classification illustrates the different meanings currently assigned to the term periodontal disease.

The terminal effect of periodontal disease observed in adults have their inception earlier in life. Gingival disease in childhood may progress to jeopardize the periodontium of the adult. The increasing awareness of the prevalence of gingival and periodontal disease in children, coupled

with the need for more information regarding the early stages of periodontal disease, have focused attention upon the periodontium in childhood.

Gingivitis, inflammation of the gingiva, is the most common form of gingival disease. Inflammation is almost always present in all forms of gingival disease because of the bacterial plaque, which cause inflammation and irritational factors that favour its accumulation and are very often present in the gingival environment. The inflammation caused by dental plaque gives rise to associated degenerative, necrotic and proliferative changes in the gingival tissues.

The role of inflammation in individual cases of gingivitis varies as follows :

- i) Inflammation may be the Primary and only pathologic change. This is by far the most prevalent type of gingival disease.
- ii) Inflammation may be a Secondary feature, super-imposed upon systematically caused gingival disease.
- iii) Inflammation may be the precipitating factor responsible for clinical changes in patients with systematic conditions that of themselves do not produce clinically detectable gingival disease. Gingivitis in pregnancy is an example.

The most common type of gingival disease is the simple inflammatory

involvement caused by bacterial plaque attached to the tooth surface. This type of gingivitis, sometimes called Chronic marginal gingivitis or simple gingivitis, may remain stationary for indefinite periods of time or may proceed to destruction of the supporting structures (Periodontitis).