

**Delineating the importance of General Pathology in Dental Education**

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**Abstract**

Oral and systemic health is inextricably linked. For decades, researchers have been interested in the link between dental health and overall health. Systemic diseases influence oral health, either directly via pathological pathways or indirectly via disease-related behavioural changes. While the influence and mouth symptoms of certain systemic diseases were identified early, more research into the possible impact of oral diseases on chronic systemic conditions was conducted. In light of the existing findings, comorbidities linked to shared risk factors appear to be a better explanation than a causal link between oral and overall health. As a result, it is critical that dental students have a thorough understanding of the fundamentals of underlying illnesses. The present paper provides a scoping review of the inter-relationship between oral and systemic diseases and outlines the significance of General Pathology as an important discipline in dental curricula.

**Keywords:** Dental; Dentistry; Education; Pathology.

**Introduction**

Medicine has undergone a complete change from a factual concept to a scientific basis over the last many years. As a result, human physiology and pathology form the keystone in the modern medical and dental curriculum. ‘General Pathology’ is defined as the study of the causes and effects of disease or injury. <sup>(1)</sup> It predicts the expected or actual course of specific diseases.

As per the Medical Council of India (MCI), ‘General Pathology’ is one of the recognized branches of medicine. <sup>(2)</sup> The Dental Council of India (DCI) has also recognized General Pathology as a part of their BDS II-year curriculum. <sup>(3)</sup> The importance of pathology cannot be understated in dentistry as DCI has a specialized branch of dentistry called Oral pathology which besides dealing with dentistry also details pathology. <sup>(3,4)</sup>

Today, almost all diseases are multi-factorial in nature. Various systemic diseases cause oral manifestations and vice-a-versa. The basic pathological mechanism behind the causation of the diseases is essential to understand in order to correctly identify the disease, initiate proper treatment, or for making a timely referral of a patient. A thorough examination of the oral cavity may uncover signs and symptoms of a systemic illness, allowing for early diagnosis and treatment. As a result, a dentist should be well-versed in the pathological relationship between systemic and oral health, as well as be prepared to work with medical subspecialists to coordinate care. This article provides a scoping review of the oral manifestations of systemic disease as well as oral diseases which can be a focus of systemic disease.

**Relationship between General Pathology and Oral Pathology**

If the eyes are the windows to the soul, the oral cavity frequently reflects the overall health status of the body.

Figure 1: Systemic Diseases caused by Oral Conditions/ Pathology

ORAL CONDITIONS	MAJOR POSSIBLE ORAL CAVITY BASED ETIOLOGIES	ASSOCIATED SYSTEMIC DISEASES
Poor Oral Health	Endotoxins released from chronic inflammation, metastatic infection, and vascular injury inside oral cavity	Atherosclerotic Disease
Periodontitis	Oral bacteria ( <i>S. Sanguis</i> , <i>P. Gingivalis</i> ) induce platelet aggregation initiating thrombus formation; Release of high levels of pro-inflammatory mediators such as PGE2, TNF $\alpha$ , and IL-1b in the blood; Overestimated host response to a microbial or LPS challenge	Cardiovascular Disease
Gingivitis/ Periodontitis	<i>S. Pneumoniae</i> , <i>Mycoplasma</i> , <i>H. Influenzae</i> , <i>AActinomycetemComitans</i> , and other anaerobes such as <i>P.gingivalis</i> and <i>Fusobacterium</i> species, can be aspirated from the oropharynx into the lower respiratory tract and result in various pulmonary diseases	Pulmonary Disease
Localised mouth inflammation	Advanced glycation end products are responsible for increased excretion of cytokines consequences to local inflammation which leads to loss of connective tissue	Diabetes Mellitus
Localised mouth inflammation	Decreased bone density in the jawbone resulted in more alveolar bone restoration, increasing the depth and numbers of gingival pockets, which in turn permit the growth of periodontal pathogens in those spaces	Osteoporosis
Periodontitis	The inflamed periodontium produces many inflammatory cytokines, chemicals, LPS, and bacteria into the systemic circulation	Stroke
Poor Oral Health & Dental Procedure	The risk of infective endocarditis after a dental procedure is almost approximately 1 per 345k procedures as the causative bacteria found to be part of the host's endogenous flora	Infective Endocarditis
Periodontitis	The ratio of anaerobic gram -negative bacterial species to aerobic species is markedly elevated in dental plaque in the second trimester of pregnancy. These microorganisms produce a variety of bioactive molecules, LPS, that activates macrophages and other inflammatory cells to synthesize and release a wide variety of molecules, like cytokines IL -1b, TNF- $\alpha$ , IL-6, and PGE2 and matrix metalloproteinases	Pregnancy & Low Birth Weight

Immunologic diseases, endocrinopathies, hematologic problems, systemic infections, and nutritional issues can all be detected through an oral examination. Periodontal disease has also been linked to diabetes, heart disease, stroke, and poor pregnancy outcomes in several studies. A two-way mechanism demonstrates the basis of this relationship <sup>(5)</sup>:

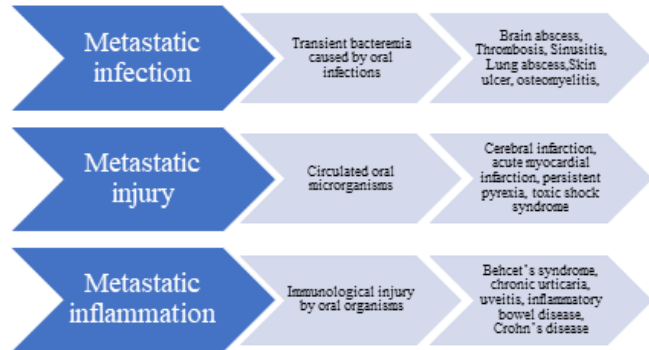
- (a) any change in the homeostasis of mouth cavity tissues can cause changes in the rest of the body
- (b) any systemic disease can influence the development and reactivity of oral cavity tissues.

**Systemic diseases caused by Oral Pathology**

Atherosclerosis, stroke, lung diseases, diabetes mellitus, pregnancy, low birth weight, osteoporosis, and renal disease are some of the systemic conditions that are influenced by oral lesions/pathology, either coincidentally or causally as depicted in Figure 1.

Three types of pathways have been postulated which represent the association of oral infections to secondary systemic outcomes<sup>(6,7,8)</sup> as shown in Figure 2.

Figure 2: Association of Oral infections to Secondary Systemic outcomes



### Atherosclerotic disease

The constriction of arteries caused by the accumulation of cholesterol and cholesterol compounds in vessel walls is known as Atherosclerosis. Many studies have shown that those who have had a myocardial infarction have worse dental health than people who have never had one.<sup>(9, 10,11)</sup>

### Cardiovascular Diseases

Periodontal diseases form a platform for cardiovascular disease. Apart from various theories<sup>(12,13,14)</sup>, a logical correlation has also been postulated between oral infection and tooth loss.<sup>(15)</sup> The difficulty in chewing, changed their eating habits turn towards consumption of high-calorie, high-fat diet avoiding nutritious foods. This dietary selection predisposed individuals to the risk for cardiovascular disease.<sup>(16)</sup>

### Pulmonary disease

The lower respiratory tracts are normally sterile, while the secretions from the upper respiratory tracts are very much loaded with microorganisms due to direct exposure of oral and nasal surfaces to the outer environment. Studies revealed that almost all pulmonary diseases like pneumonia, chronic obstructive pulmonary diseases, and aggressive state of chronic bronchitis are

occurred because of the aspiration of bacteria.<sup>(17, 18)</sup> A significant relationship was observed between patients with poor oral hygiene and aspiration pneumonia. Also found it was observed that the health care centers with the minimal number of dental visits and care had the highest number of deaths due to pulmonary diseases.<sup>(19)</sup>

### Diabetes mellitus

Diabetes is a glycaemic control disorder caused by either insufficient insulin production (type 1) or systemic insulin resistance (type 2). The connection between diabetes and oral pathologic conditions is truly bidirectional. It is well documented that hyperglycaemic states have a negative impact on oral health and vice versa.<sup>(11, 20)</sup>

### Osteoporosis

It is defined as an imbalance between bone loss and the formation of new bone. The outcome of this defect is decreased bone mineral density in the body. Interleukin-6, known as the driver of bone loss, is increased locally and systemically as a result of this chronic infection. Several studies concluded that periodontal disease exhibits a positive relationship with osteoporosis.<sup>(5, 8)</sup>

### Stroke

Stroke is a cerebrovascular disease that involves small blood vessels blockage by thrombus, which hampers providing blood and nutrition to the central nervous system. In a case-control study<sup>(21)</sup>, the dental state of 40 cerebral infarction patients under the age of 50 and 40 randomly selected community controls matched for sex and age were compared. The patients with cerebral infarction had a lower oral health score than those in the control group.

### Infective Endocarditis

It's a bacterial infection that affects the heart valves or endothelium. Bacteria in the circulation deposit on faulty heart valves or wounded heart endothelium, causing

heart failure. There are more than 1,000 case reports that have been recorded which presented the association of dental procedures or disease with the onset of endocarditis. (22) A great number of case-control studies have recently been carried out; all further supported this relationship. (23, 24, 25)

**Pregnancy and Low birth weight**

Numerous studies have highlighted that periodontal disease may have the capacity to affect pregnancy outcomes and Low Birthweight babies. (26, 27) The microvasculature, gingival permeability, and enhanced synthesis of estrogen PGs are all likely to change during pregnancy, and if they breach the placental barrier, they can cause premature labor induction. Periodontal disease

may be the cause of 18.2 percent of preterm, low-birth-weight newborns, according to Offenbacher et al. (28)

**Oral Pathology caused by Systemic Diseases**

The oral cavity is compromised by many systemic ailments. The oral cavity frequently shows signs of systemic disease before the systemic disease is identified. The evaluation of oral mucosa, palate, tongue, gingival surfaces, and dentition is essential to identify a systemic pathology at a very early stage. These oral lesions may act as adjuncts to the clinical diagnosis of various syndromes or are considered to be the most common alarming signs observed by health care providers as depicted in Table 1.

Table 1: Oral Pathology caused by Systemic Diseases.

Systemic disease	Affected Part in Oral Cavity	Suggestive Conditions/pathology	Oral
HSV, Diabetes mellitus	Oral mucosa	Dry /cracked lips	
Anemia		Mucosal pallor	
Addison’s disease, McCune-Albright syndrome, Peutz-Jegher’s syndrome, and Neurofibromatosis type 1		Dark pigmentation of Oral Mucosa	
Chronic liver diseases		Yellow oral mucosa	
Trauma, Medications such as non-steroidal anti-inflammatory agents (NSAIDs), nicorandil and angiotensin-converting enzyme (ACE), Bisphosphonates.		Painless aphthous ulcer	
Ulcerative colitis, Behçet syndrome, Stress		Painful aphthous ulcer	
Systemic lupus erythematosus, Lichen planus		Discoïd ulcer	
Pemphigus		Painful blisters	
Crohn’s disease		Diffuse mucosal swelling and cobblestoning of the oral mucosa	
Vitamin A deficiency		Dryness of the oral mucosa and Leukoplakia	
Iron deficiency anaemia	Tongue	Plummer-Vinson syndrome (glossitis, dysphagia, and oesophageal webs)	
Oral and Oesophageal squamous cell carcinoma			
Pernicious anaemia		Burning and pain of the tongue,	

		Erythematous spots on the ventral surface (magenta tongue).
Kawasaki disease		Ulcers, swelling of papillae of the tongue (strawberry tongue), and erythema of the mucosal surfaces.
Vitamin A/ B12 deficiency		Angular cheilitis
Sarcoidosis		Keratotic painless ulcers
Amyloidosis, Acromegaly		Macroglossia
Cowden's syndrome		Multiple hamartomas
HIV	Gingiva	Band of gingival erythema, Necrotizing ulcerative gingivitis, Gum bleeding
Heavy metal poisoning (Lead and Mercury)		Blue-grey band in gingiva underneath the teeth
Thrombocytopenia		Petechiae, purpura or ecchymosis, spontaneous hemorrhage
Acute monocytic and acute myelomonocytic leukemia		Mucosal bleeding, ulceration, and petechiae
Wegener's granulomatosis.		Strawberry gingivitis
Non-Hodgkin's lymphoma		Boggy mass in gingival tissues with lymphadenopathy
Medications (phenytoin, calcium channel blockers, cyclosporine)		Gingival hyperplasia
Niacin (Vitamin B3) deficiency		Erosions and aphthous ulcers
Multiple myeloma	Alveolar bone / Mandible	Asymmetry of the jaw, swelling, numbness, impaired mobility of teeth, pathologic fractures.
Letterer-Siwe disease in infants		Mandibular fractures, displaced teeth
Langerhans cell histiocytosis (LCH)		Alveolar bone loss with premature primary teeth loss in young adults
Burkitt's lymphoma		Marked tooth mobility, Early loss of teeth
Breast and Lung Carcinoma		Pain in jaw
GERD (Gastroesophageal reflux disease)	Dentition	Erosion of dental enamel
Anorexia/bulimia nervosa		Dental caries

Sjogren Syndrome		
Tetracycline exposure, Oral iron intake		Grey band in the enamel of the teeth
Fluoride intake		white lacy appearance to the incisors and molars

**Systemic Diseases affecting Oral Mucosa**

Systemic lupus erythematosus (SLE) is a multisystem disorder involving the oral mucosa in up to 45% of patients. Approximately 4 – 20% of the patients with ulcerative colitis can have aphthous ulcers. (29) Almost 40% of people with oral lichen planus (LP) also experience cutaneous or other mucosal lichen planus symptoms. (30, 31) In nearly half of Pemphigus Vulgaris patients, the oral cavity is the primary site of involvement, and without therapy, 95% of patients will develop oral lesions. (32, 33)

**Systemic Diseases affecting Tongue**

Migratory glossitis or erythema migrans is a typical sign in many systemic diseases affecting almost 2% of our population. (34) Plummer-Vinson syndrome, which is associated with iron deficiency anemia, is linked to a high occurrence of oral and oesophageal squamous cell carcinoma. (35)

**Systemic Diseases affecting Gingiva**

“Strawberry gingivitis” is a remarkable pointer of Wegener’s granulomatosis in 30% of cases. It also leads to loss of underlying alveolar bone as well as increased tooth mobility. (35)

**Systemic Diseases affecting Alveolar Bone (Mandible)**

Lesions of the jaw are documented in approximately 25% of sarcoidosis patients. Multiple myeloma typically involves the jawbones (30%) in the late phases of the disease. (34) The multiple “punched out” areas can be noticed on the x-ray. (29) Almost 50-70% of African Burkitt’s lymphoma patients exhibit alveolar bone mass.

(29) Like the early finding of the undiagnosed malignancy, the molar region of the mandible is the most common location for oral metastatic emboli. (36)

**Systemic Diseases affecting the dentition**

Regurgitation of gastric contents in the oral cavity leads to lowering of pH of the mouth below 5.5 leading to the destruction of the dental enamel. (37) Palatal surfaces of the maxillary dentition are the first to undergo erosion and finally dental caries. Sjogren Syndrome is linked to reduced salivary content, which affects the saliva's ability to dilute dietary carbohydrates, which can lead to dental caries.

**Conclusion**

Thus, the mouth cannot be considered in isolation from the rest of the body. It's important to recognize that the association between oral and systemic diseases is a fast-developing field of study and that early discovery of oral disorders can aid in the early diagnosis and treatment of a variety of systemic diseases. It makes no difference who examines the patient first and discovers a risk factor or early signs of sickness from a health standpoint.

Therefore, every dental student should understand its importance in order to succeed in life as a Dental Expert and also a Health Care Worker. Even though ‘General Pathology’ may not occupy as much room in a dental school curriculum as other disciplines but it is still a vital aspect of dental education.

**Declarations**

**Ethical Clearance:** This study is a review article and is limited to the analysis of available data from published studies, so ethical approval was exempted.



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