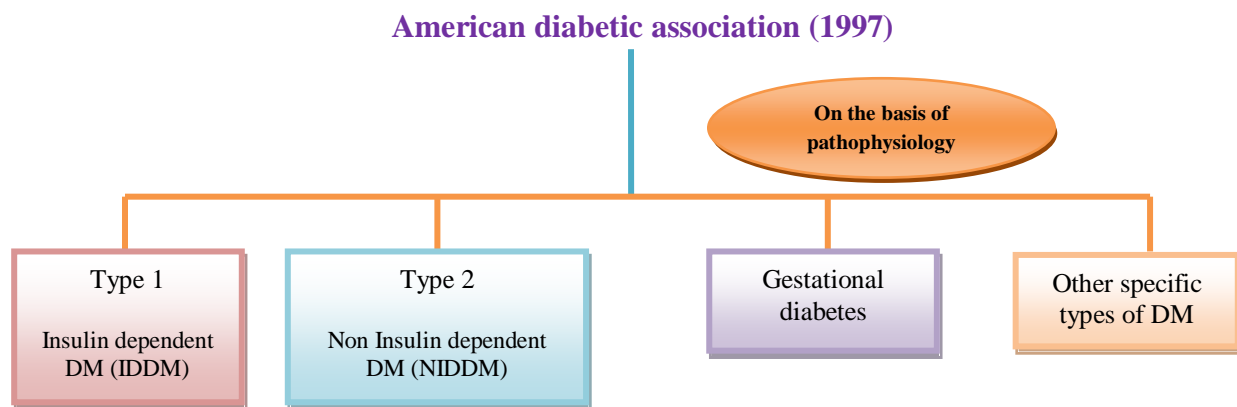


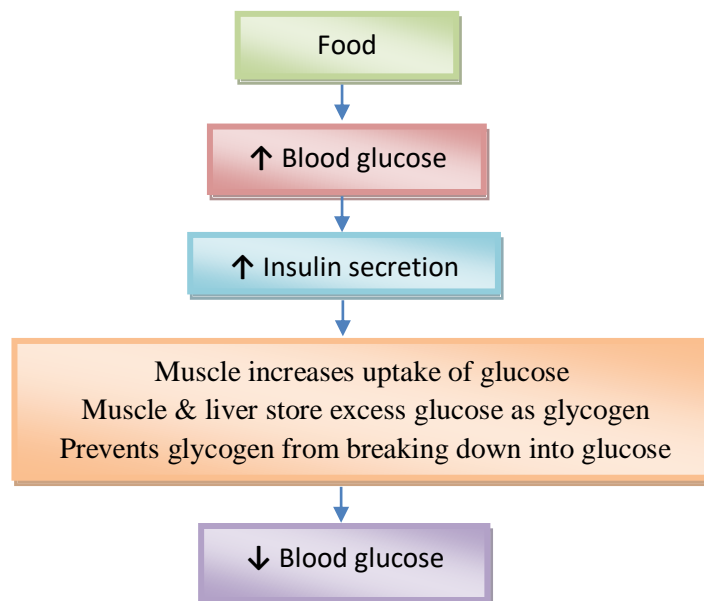
## DIABETES AND PERIODONTAL DISEASE: A BI-DIRECTIONAL RELATIONSHIP

Periodontal medicine is defined as a rapidly emerging branch of Periodontology which focuses on establishing a strong relationship between periodontal health or disease and systemic health or disease.

Diabetes mellitus is defined as a complex metabolic disorder characterized by chronic hyperglycemia, diminished insulin production, impaired insulin action or a combination of both result in the inability of glucose to be transported from the blood stream into the tissues, which in turn results in high blood glucose levels.



### ***CONTROL OF BLOOD GLUCOSE BY INSULIN:***



**LABORATORY DIAGNOSIS FOR DIABETES MELLITUS:**

	<i>Normal</i>	<i>Impaired Fasting Glucose</i>	<i>Diabetes Mellitus</i>
<i>Fasting glucose</i>	<i>&lt;110 mg/dl</i>	<i>110-126 mg/dl</i>	<i>≥ 126 mg/dl</i>
<i>2h postprandial glucose</i>	<i>&lt;140 mg/dl</i>	<i>140- 200 mg/dl</i>	<i>≥ 200 mg/dl</i>

HbA1c test measures the percentage of HbA1c in blood. It reflects the average blood glucose over a period of past two to three months (8 - 12 weeks)

HbA1c refers to hemoglobin which is bound to glucose

HbA1c test is done to

- Diagnose Diabetes
- To monitor Diabetes

**Glycosylated Hemoglobin (HbA1c) Test**

\*Reference range may vary from Lab to Lab

**COMPLICATIONS OF DIABETES MELLITUS:**



## PERIODONTAL MANIFESTATIONS:



Gingival hyperplasia



Multiple abscess formation



Polyploid gingival proliferation



Periodontitis



Loosened teeth

## FACTORS POTENTIALLY CONTRIBUTING TO SEVERITY OF PERIODONTAL DISEASES:

- ✓ **Effect on microbiota** - In uncontrolled diabetic patients, there is increased percentage of spirochetes, motile rods and decreased levels of cocci in periodontal lesions. Subgingival flora mainly consists of capnocytophaga, anaerobic vibrios, actinomyces species, P. gingivalis, P.intermedia, A.actinomycetemcomitans.
- ✓ **Effect on host response** – Impairment of Polymorphonuclear leucocytes (PMNs).  
Studies have suggested that large numbers of PMNs are present in inflamed gingival crevices of patient with uncontrolled diabetes.

Advanced Glycated Endproducts (AGEs)  enhances NADPH Oxidases & Respiratory burst of neutrophils, which causes local tissue damage

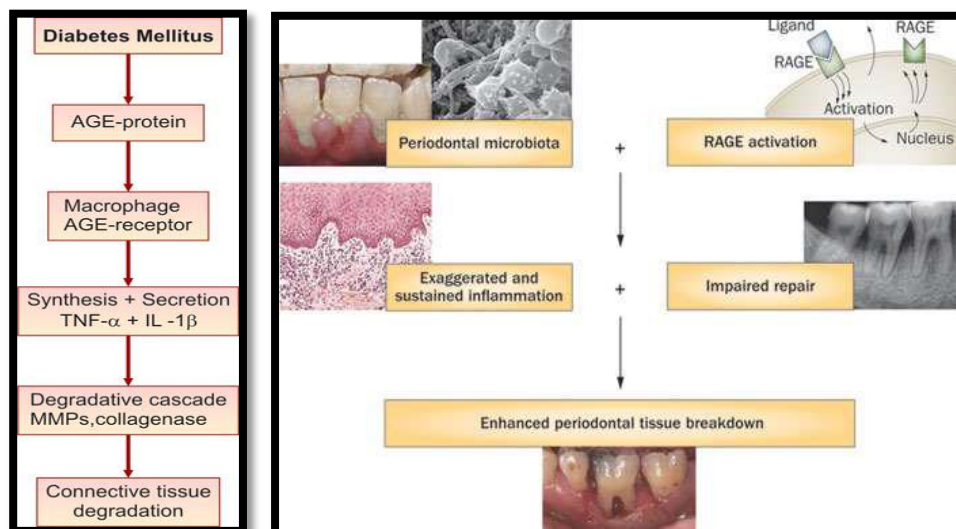
**Arachidonic acid is a mediator of AGE augmented neutrophil respiratory burst**

↓  
**Upregulate neutrophil NADPH**

↓  
**Local production of ROS**

*Cytokines, monocytes & macrophages* - There is hyperglycemia mediated formation of nonenzymatic AGEs. Macrophages have high affinity receptors for AGE – modified proteins (RAGE). AGEs form and accumulate in a number of circumstances, such as aging, renal failure and diabetes. Accumulation may result in significant alteration of normal cellular composition and structure.

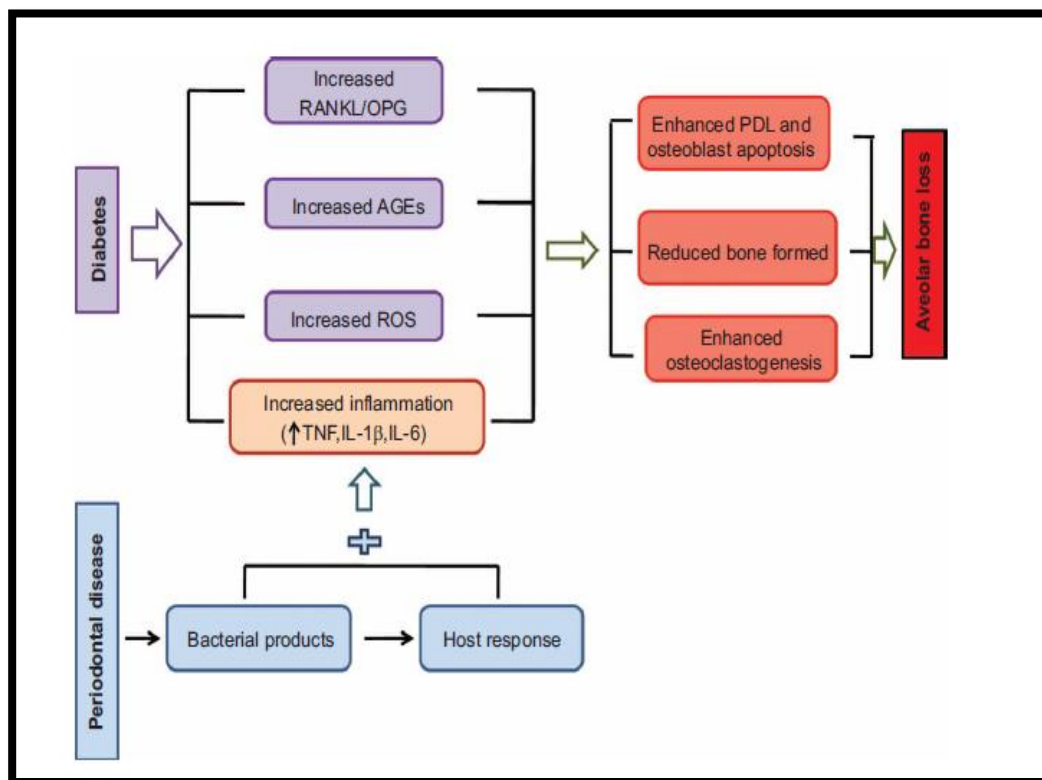
- *The receptor for AGE (RAGE) and target cell dysfunction* - RAGE is present at low levels in a number of cell types, including endothelial cells, smooth muscle cells, neurons & monocytes. However, in perturbed states, such as diabetes, renal failure, Alzheimer's disease, and inflammation, the expression of RAGE on critical target cells is strikingly enhanced. The interaction of AGEs and RAGE results in induction of enhanced cellular oxidant stress alters cellular phenotype & function by activation of cell-signaling pathways that eventuate in activation of nuclear factor-kB.



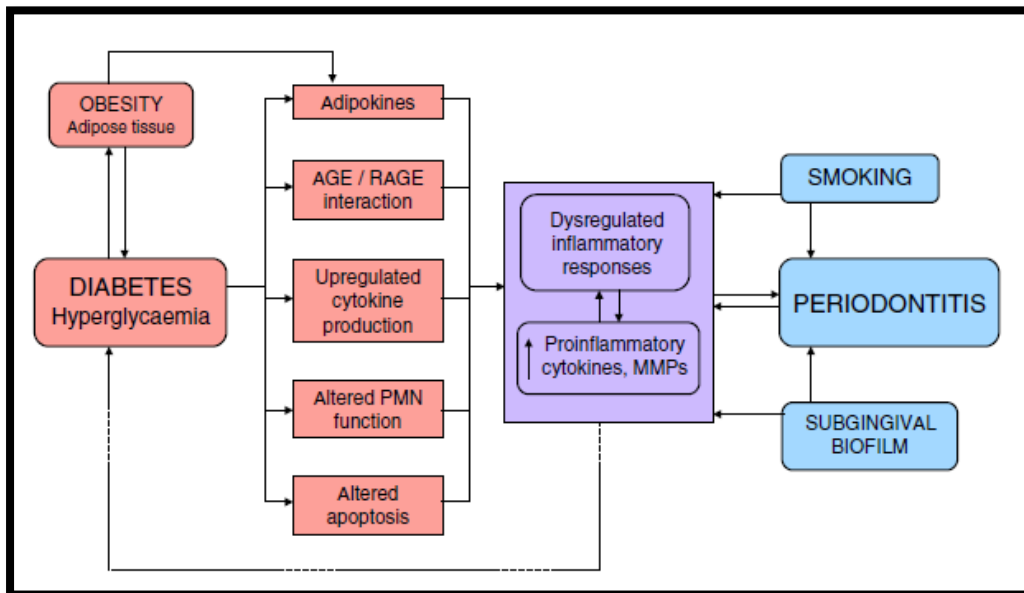
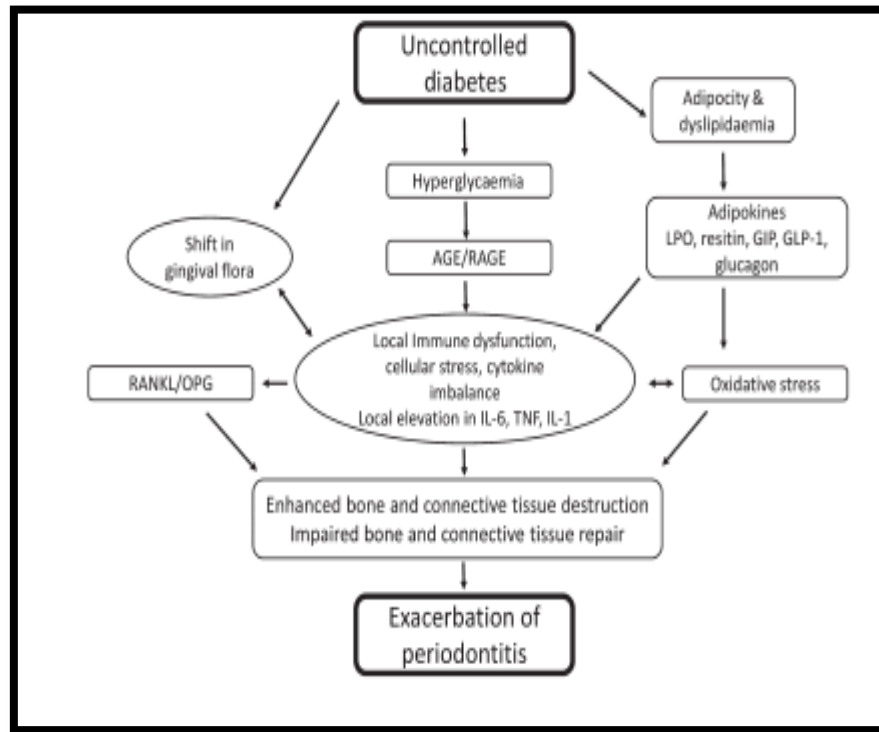
- ✓ **Altered collagen metabolism** – Increased in collagenase activity and decrease in collagen synthesis. AGE forms cross-linking collagen, making it less soluble and less likely to be normally repaired or replaced. As a result, collagen is aged and more susceptible to breakdown.
- ✓ **Altered bone metabolism** - Enhance osteoclast formation in inflamed areas. Significantly higher levels of local inflammatory mediators such as IL-1 $\beta$ , TNF- $\alpha$  and prostaglandin E2, which result in more prolonged osteoclast formation and activity.

Enhance the Apoptosis of osteoblastic cells, thereby reducing osseous coupling. Upregulation of pro-apoptotic factors for Osteoblasts, including advanced TNF- $\alpha$ , AGEs and formation of (reactive oxygen species) ROS, each of which can contribute to apoptosis.

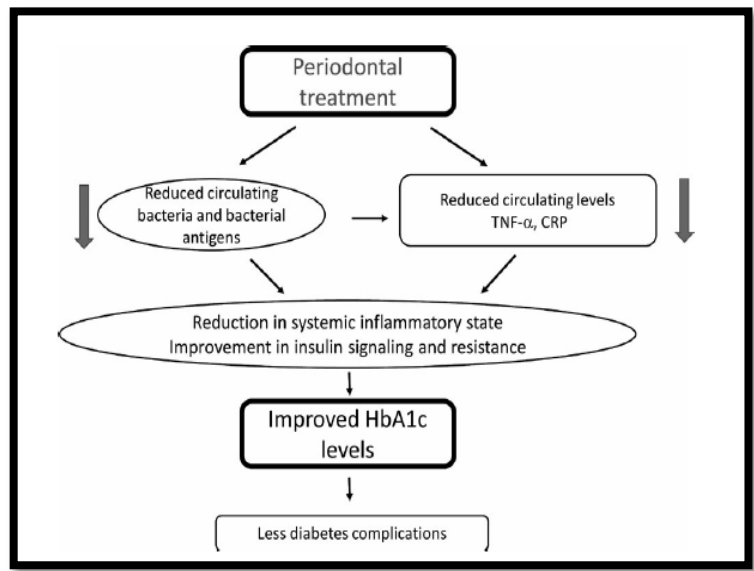
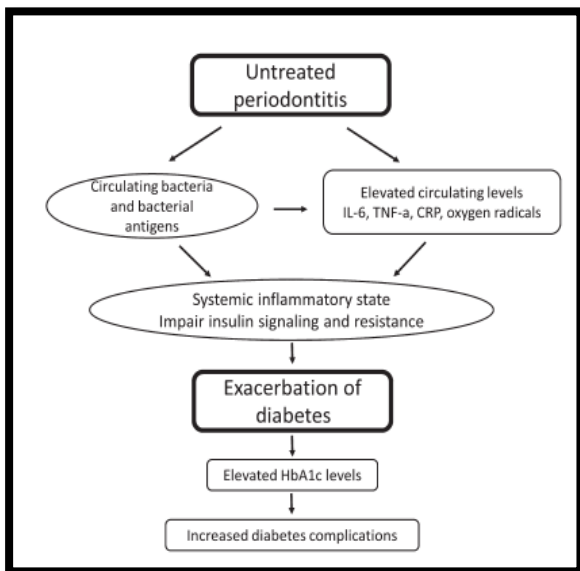
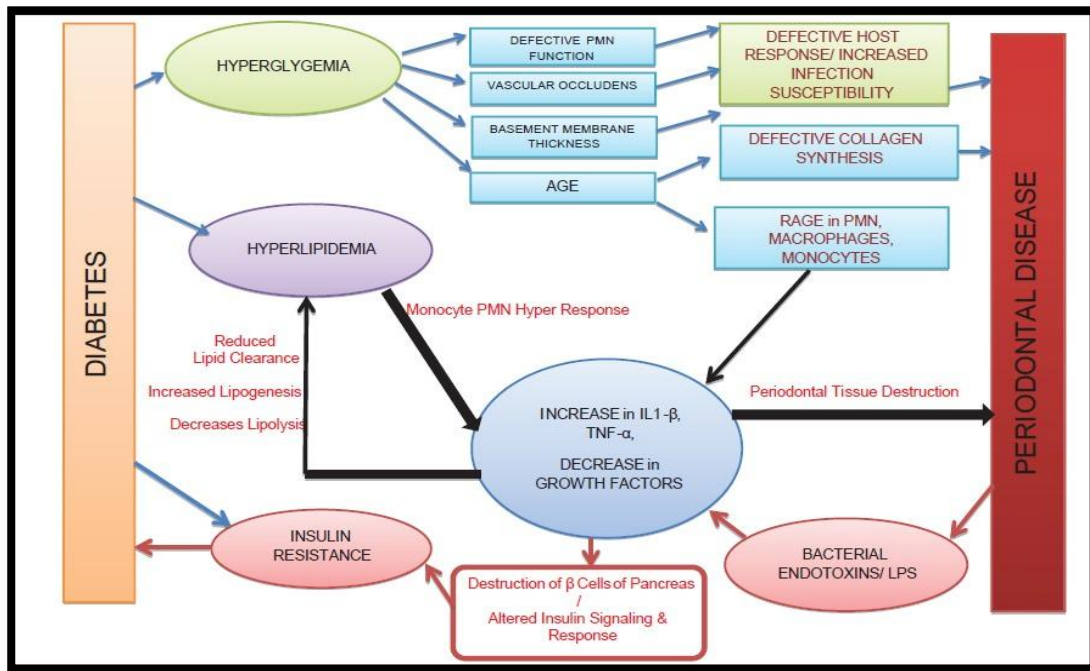
**POTENTIAL MECHANISM OF DIABETES-RELATED ALVEOLAR BONE LOSS IN PERIODONTAL DISEASE:**



***PATHOGENESIS OF PERIODONTITIS IN DIABETES:***



**POTENTIAL MECHANISTIC LINKS IN THE BIDIRECTIONAL INTERRELATIONSHIP BETWEEN DIABETES AND PERIODONTAL DISEASE:**



### ***STUDIES REVEALING EFFECT OF DIABETES ON PERIODONTITIS:***

Cianciola et al	1982	In children with type 1 diabetes, the prevalence of gingivitis was greater than in non-diabetic children with similar plaque levels.
Sastrowijoto S et al	1990	Improvement in glycemic control may be associated with decreased gingival inflammation.
Papapanou PN	1996	Majority of the studies demonstrate a more severe periodontal condition in diabetic adults than in adults without diabetes.
Tsai C et al	2002	In a large epidemiologic study in the United States, adults with poorly controlled diabetes had a 2.9-fold increased risk of having periodontitis compared to non-diabetic adult subjects; conversely, well-controlled diabetic subjects had no significant increase in the risk of periodontitis.
Salvi GE et al	2005	Rapid and pronounced development of gingival inflammation in relatively well-controlled adult type 1 diabetic subjects than in non-diabetic controls, despite similar levels of plaque accumulation and similar bacterial composition of plaque, suggesting a hyperinflammatory gingival response in diabetes.

### ***STUDIES SHOWING EFFECT OF PERIODONTAL DISEASE ON DIABETES:***

Williams RC Jr., Mahan CJ.	1960	Type 1 diabetic patients with periodontitis had a reduction in required insulin doses following scaling and root planing, localized gingivectomy, and selected tooth extraction combined with systemic procaine penicillin G and streptomycin
Taylor GW et al	1996	In a 2-year longitudinal trial, diabetic subjects with severe periodontitis at baseline had a six-fold increased risk of worsening of glycemic control over time compared to diabetic subjects without periodontitis
Rodrigues DC et al	2003	Better improvement in glycemic control in a diabetic group treated with scaling and root planing alone compared to diabetic subjects treated with scaling and root planing plus systemic amoxicillin/clavulanic acid.
Promsudthi A et al	2005	In older, poorly controlled type 2 diabetic subjects who received scaling and root planing plus adjunctive doxycycline showed a significant improvement in periodontal health but only a non significant reduction in HbA1c values.

### ***CONCLUSION:***

Diabetes and periodontitis are both common chronic diseases in adults and specifically in older individuals. There is substantial evidence of the impact of periodontitis on systemic inflammatory markers.



Periodontal treatment of patients with diabetes may have limited effects on slightly elevated A1C levels, but in patients with more severe diabetes, such treatment may reduce A1C levels significantly if coordinated with blood glucose control.

Signs of periodontal inflammation, including gingivitis, can be assessed easily by all medical health care providers. Patients with periodontitis with severe gingival inflammation who do not respond to routine periodontal therapy should be screened for diabetes.

By communicating and coordinating the treatment of diabetic patients, medical and dental care providers have an opportunity to provide better care of their patients.

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