Basic Immunology

25th lecture:
Immunology of periodontal diseases

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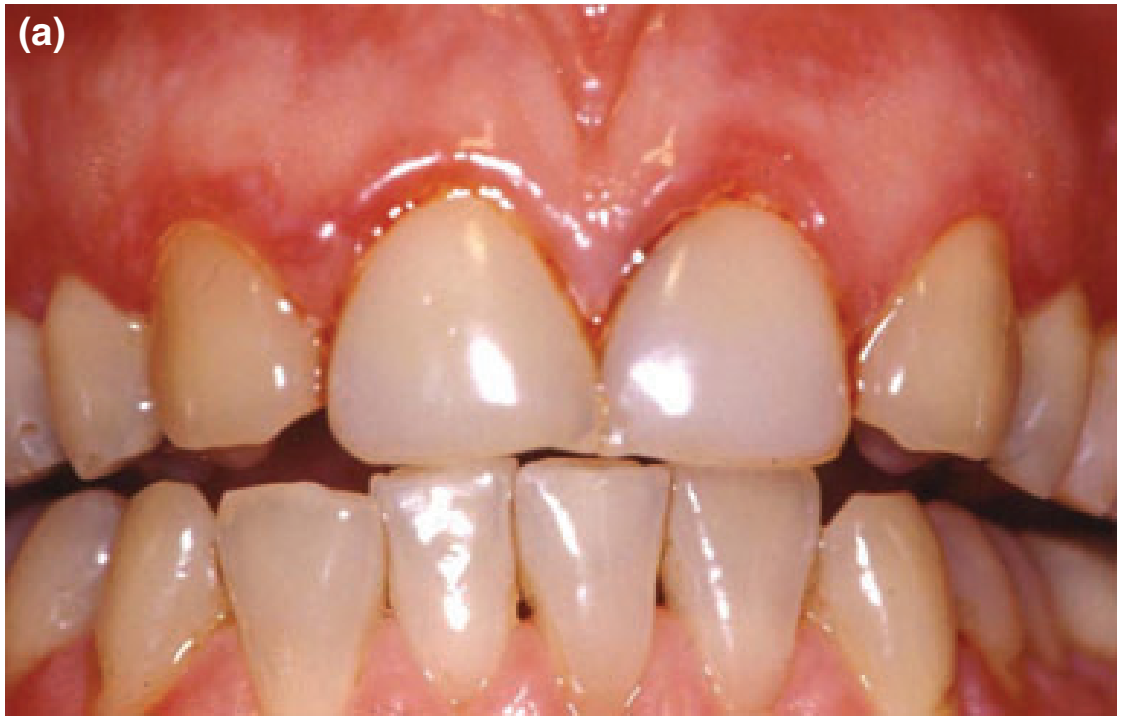
Periodontal diseases

Inflammatory diseases affecting the gingiva and supporting structures of teeth

Results in attachment loss and destruction of alveolar bone

Etiology is important for proper treatment



Marginal gingivitis

Diagnosis and classification of periodontal disease. Highfield J, Aus Dent J. 2009.

Classification of periodontal diseases (AAP, 1999)

Most common:

-Chronic marginal gingivitis (CMG)

- Inflammatory reaction to plaques
- Reversible inflammation

-Chronic inflammatory periodontal disease (CIPD)

- Adult periodontitis
- Irreversible damage
- Smoking important exacerbating factor

Pathophysiology

Bacteria ("PSD" model: polymicrobial synergy and dysbiosis)

>600 species in the oral cavity
~200 detectable in an individual

8 bacterial species have been associated with periodontal disease
- e.g.: *Prevotella intermedia* – acute necrotizing ulcerative gingivitis
- ***Porphyromonas gingivalis*** – chronic inflammatory periodontal disease

Found in both healthy and diseased sites…
~ 50% of plaque bacteria can be cultured, rest are unknown!

Pathogenic factors:
- -leukotoxins
- -endotoxin
- -capsular products (activators of bone resorption)
- -hydrolytic enzymes (collagenases, phospholipases, proteases… etc)

Bacteria and bacterial toxins can invade the periodontal epithelium

Pathophysiology

Immunogenetic factors

-*HLA association* (animal and human studies)

HLA-A9: associated with higher risk for CIPD, juvenile periodontitis, rapidly progressing periodontitis

indicate that HLA-A9 is associated with periodontal destruction

-*Genotype variants*

IL-1α, IL-1β, TNFα (pro-inflammatory); IL-4, IL-10 (anti-inflammatory)

-*Twin studies*

No difference in gingivitis, probing depth, attachment loss, and plaque in monozygous twins raised apart or together

indicate that genetic component is more important than environment

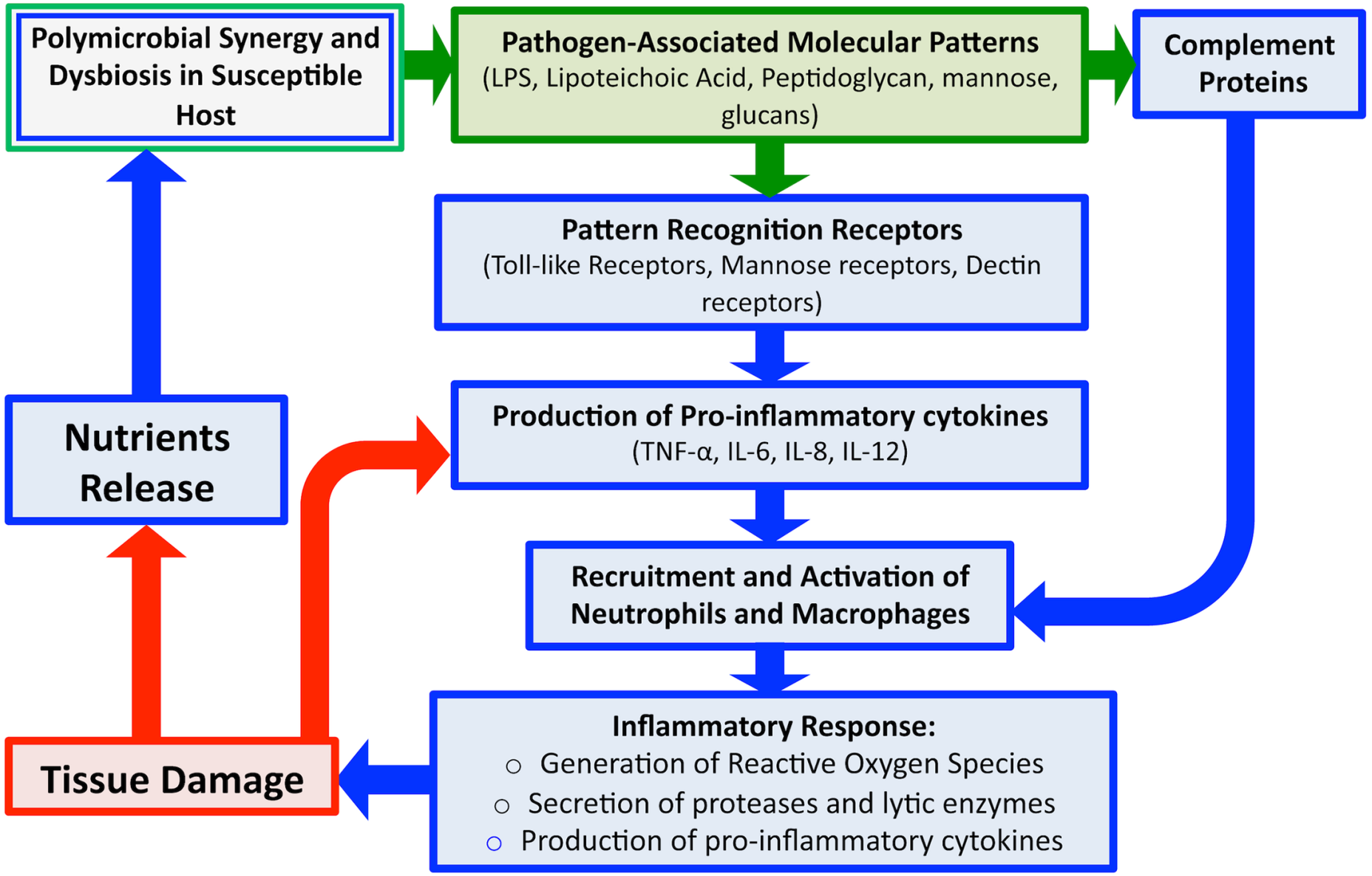
-*Antibody response*

Usually directed against Gram- bacteria; levels correlate with disease severity

e.g. increased antibody levels against *P. gingivalis* in CIPD

Both systemic and local

Pathophysiology



Periodontal diseases: bug induced, host promoted. Khan SA et al, PLOS Path. 2015.

Pathophysiology

Stages *(gingivitis always precedes periodontal disease!)*

I. Initial lesion: reversible damage to gingival sulcus, polymorphonuclear cell infiltration, complement activation

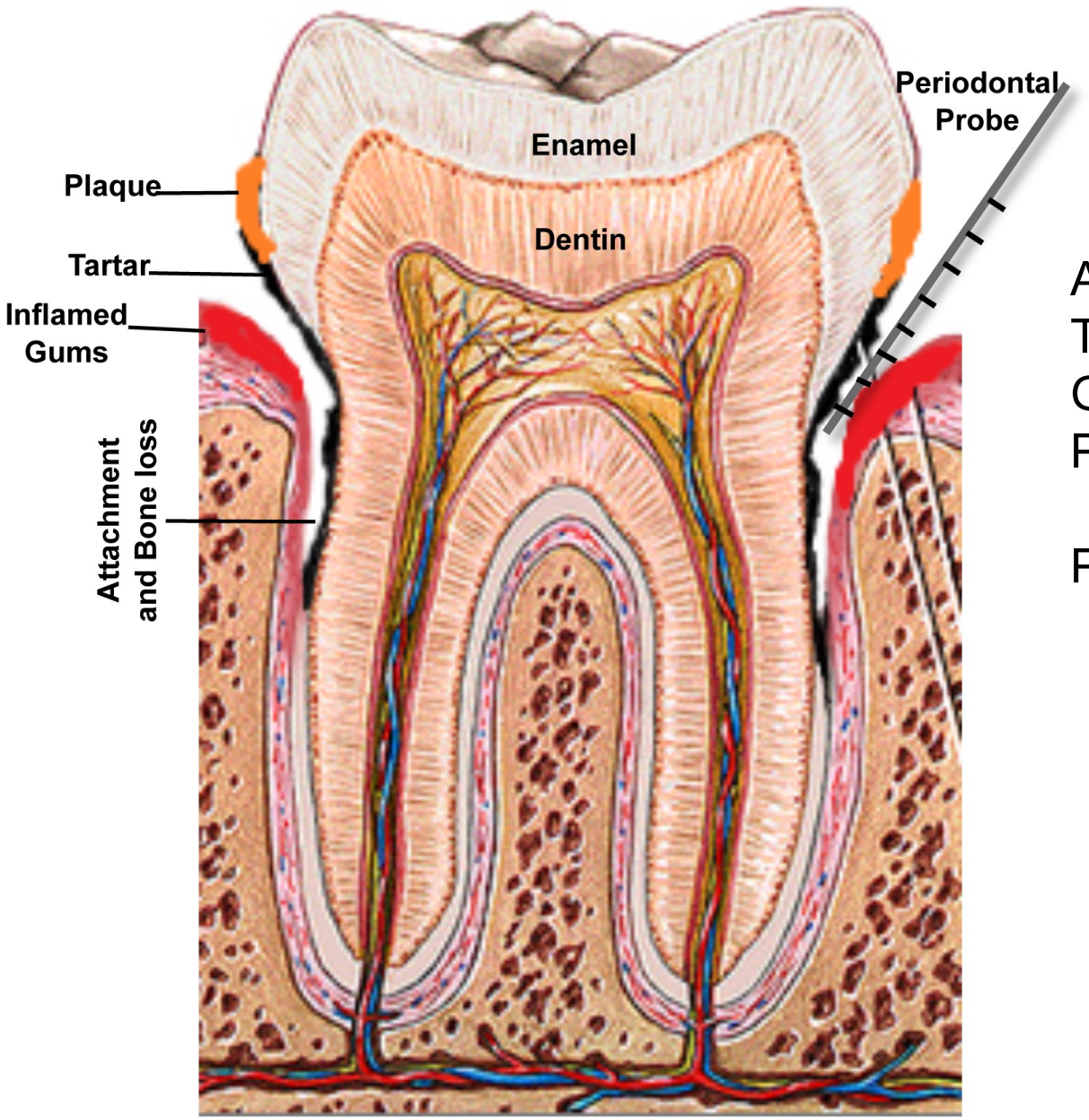
II. Early lesion: still reversible, lymphocytes replace polymorphonuclear cells. Mostly T cells (T_H17), few plasma cells

III. Established lesion: predominant plasma cell infiltration, mainly IgG^+

IV. Advanced lesion: destructive state; pocket formation, epithelial ulceration, periodontal ligament destruction, bone resorption

P. gingivalis important!

Pathophysiology



Accumulation of dental plaque
Tartar formation
Gingival inflammation
Periodontal pocket formation, loss of bone support

Pocket: 3mm< unhealthy
7mm< high risk of eventual tooth loss

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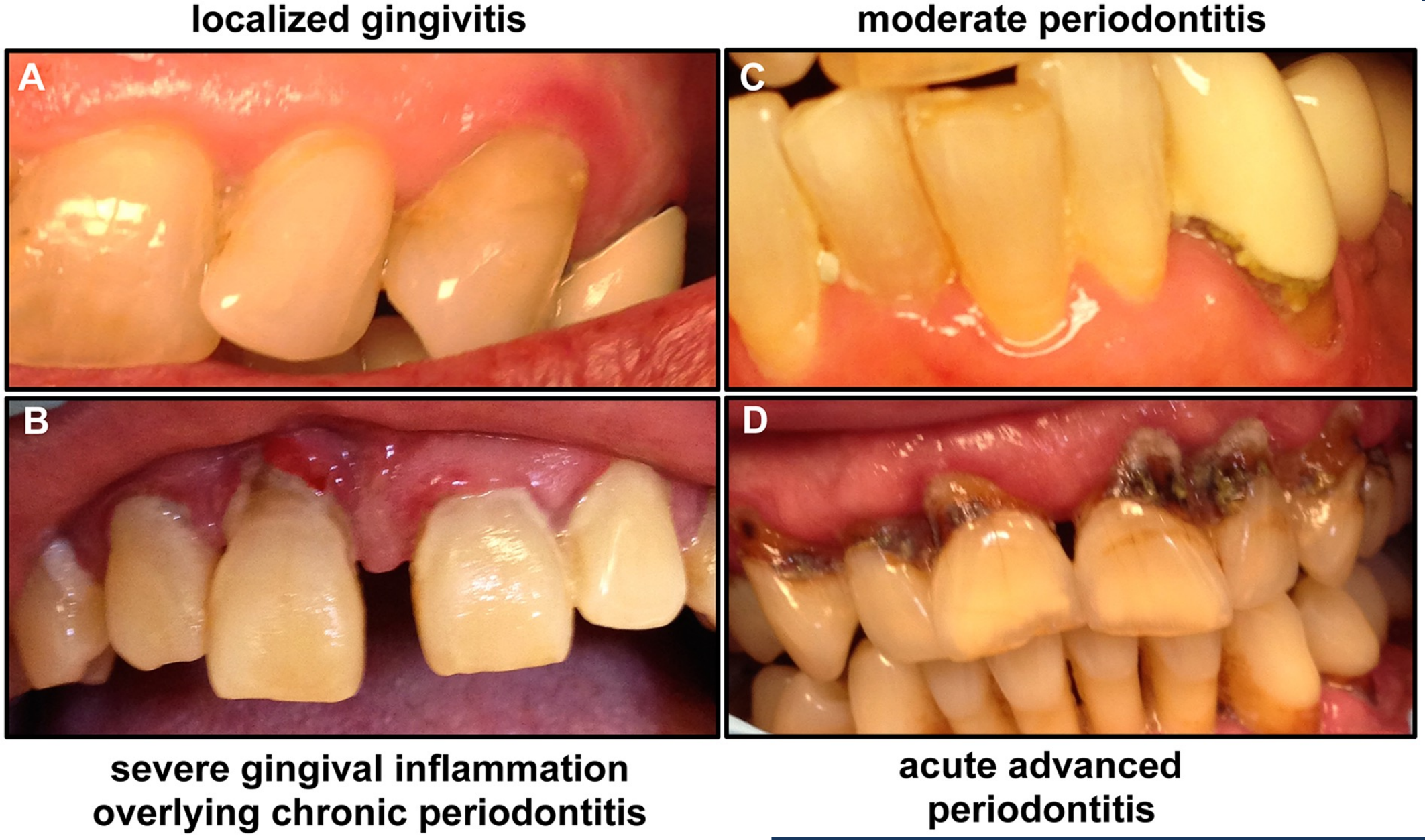
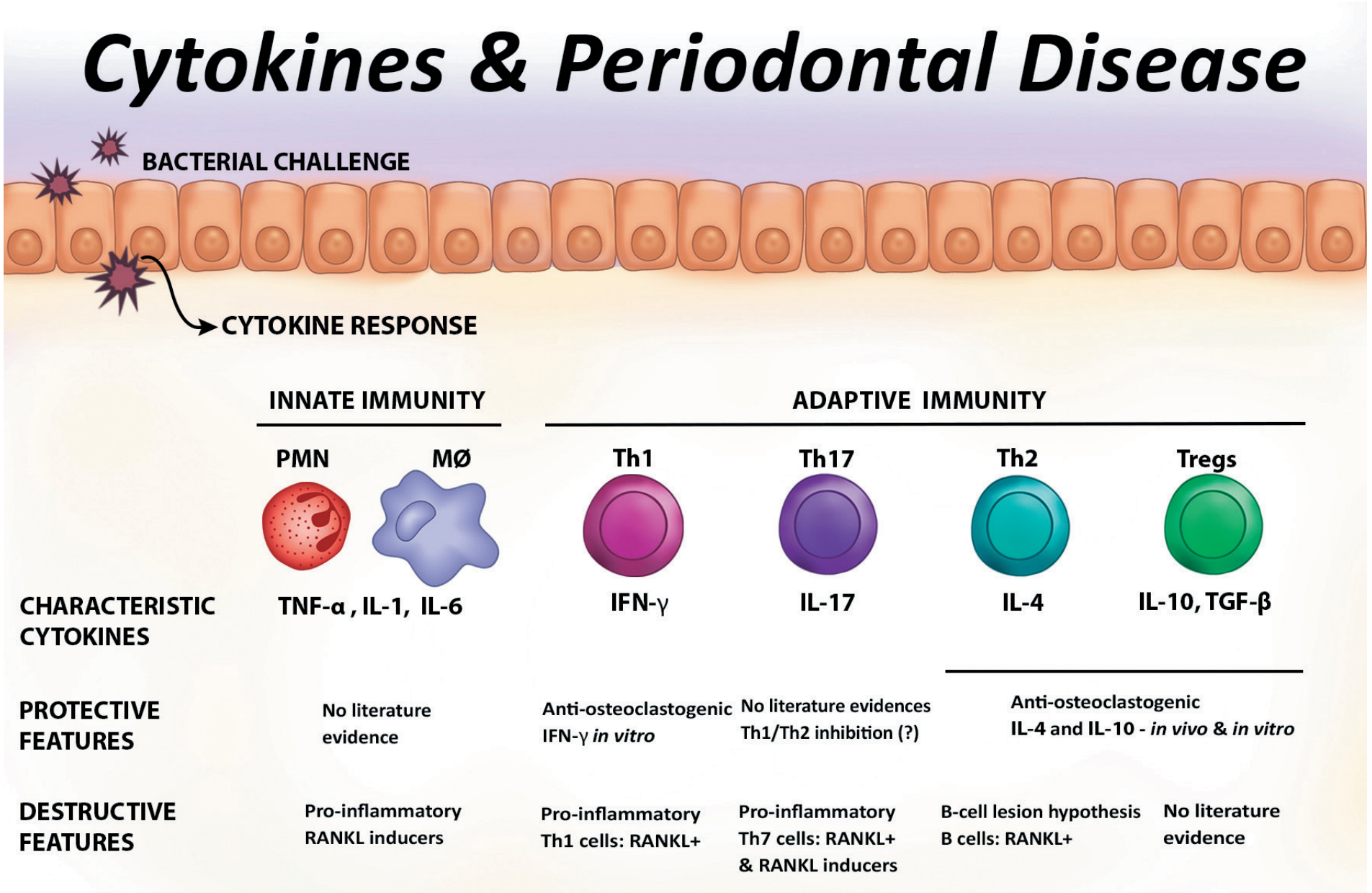
Pathophysiology



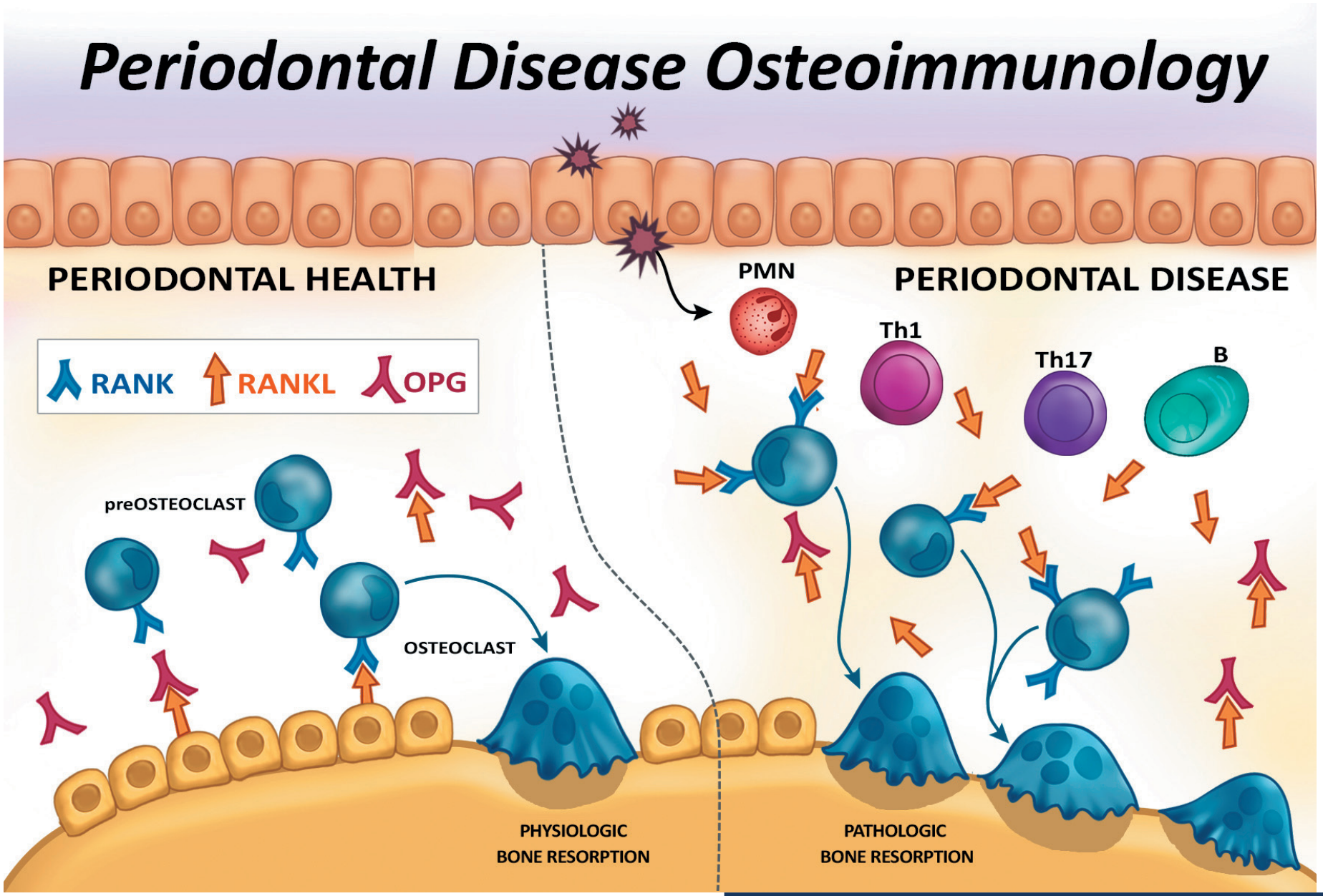
Periodontal diseases: bug induced, host promoted. Khan SA et al, PLOS Path. 2015.

Cytokines



Host response mechanisms in periodontal diseases. Silva N et al, J Appl Oral Sci. 2015.

Osteoimmunology



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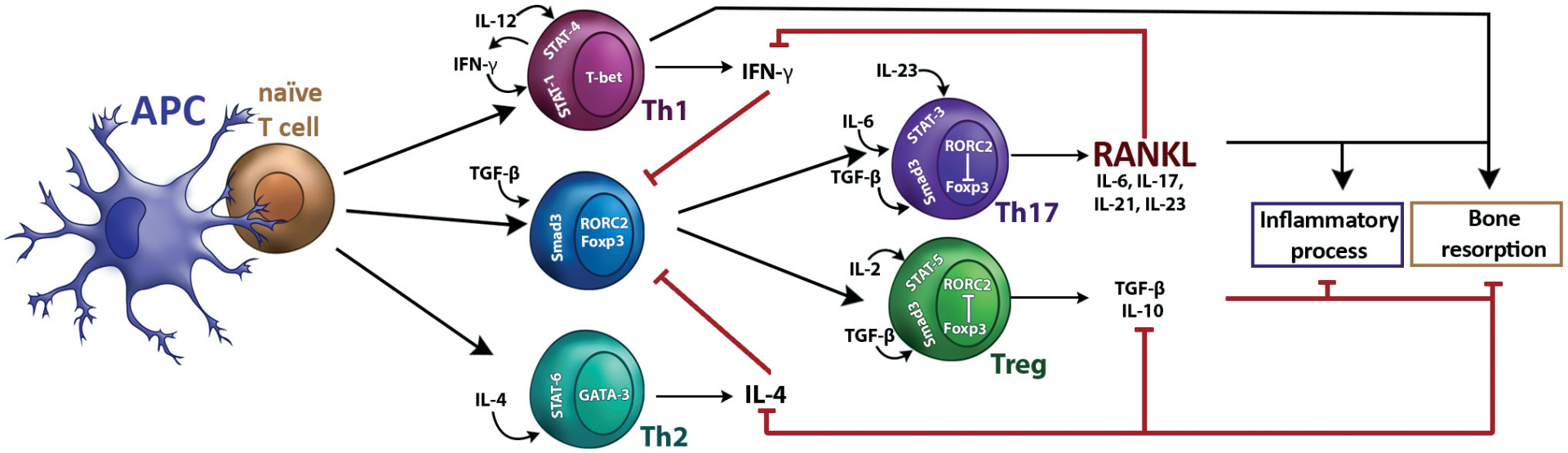

Osteoblast – Osteoclast balance:

-RANKL: binds to RANK → Osteoclast differentiation, activation

-Osteoprotegerin: binds RANKL → inhibits osteoclast activation

-T_H17 cells can produce RANKL

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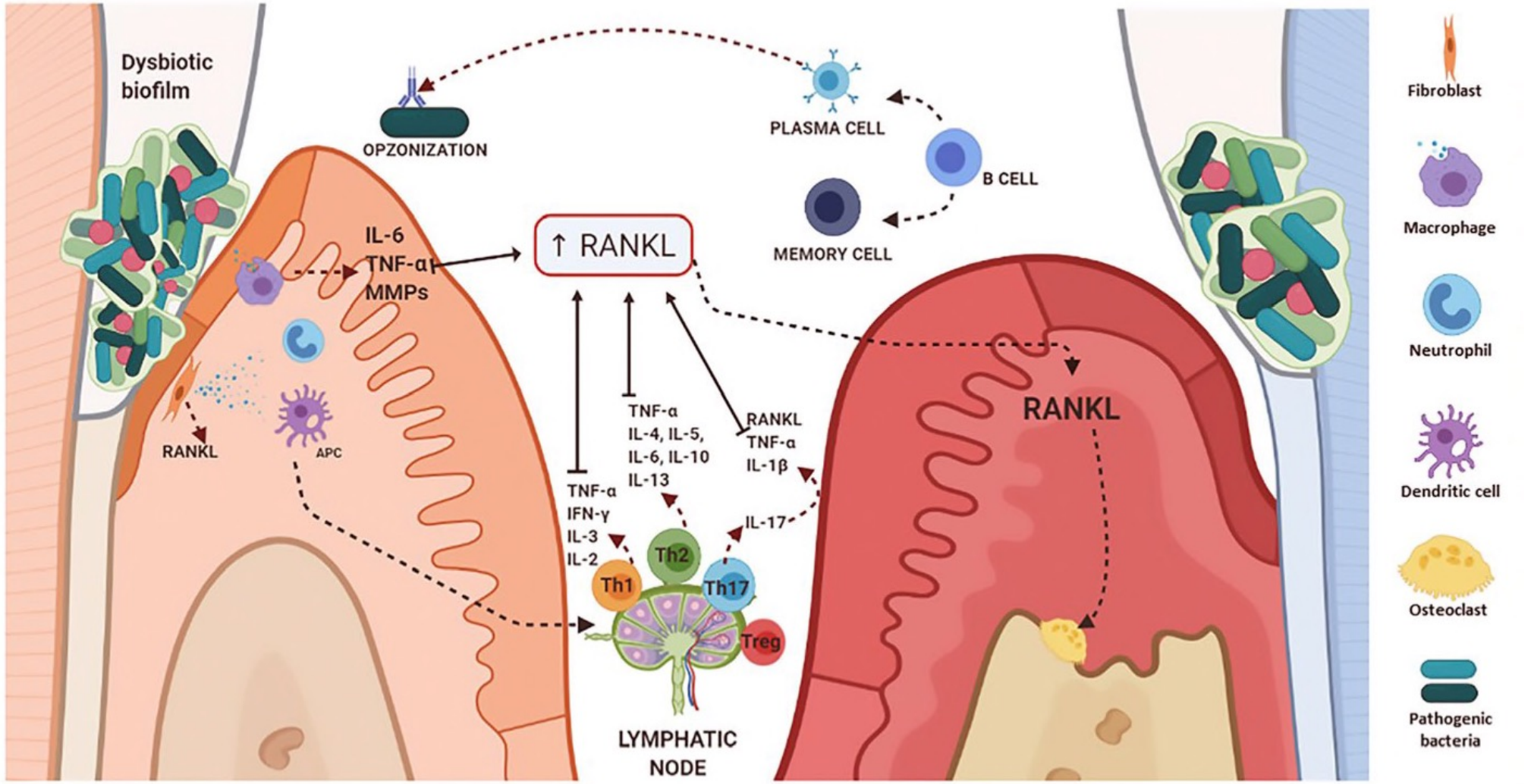
Immunology of periodontitis



Most important:
T_H17
RANKL

Innate and adaptive immunity of periodontal disease. From etiology to alveolar bone loss. Becerra-Ruiz JS, Oral Dis. 2021.