The Human Oral Microbiome in Health and Disease

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Introduction

The human oral microbiome

One of the most diverse and unique in the body

Each part of the mouth has its own unique habitat of microorganisms

Oral health and disease

Studies show association in disease and oral microbiome change

May provide potential biomarkers in diagnosis

Sequencing-based approaches

Allows for characterization of microbiome structure

Technical Approaches

Next-generation sequencing (NGS) techniques

- Cost of genetic sequencing has gone down

16S ribosomal RNA sequencing

- Less expensive, current standard
- Identifies what bacterial species are present

Whole metagenome shotgun (WMS) sequencing

- Provides a more comprehensive view of the microbial community
- “What do the microorganisms present actually do?”

Oral Cavity: Microbial Niches

Diverse habitats in the oral cavity

Subgingival and supragingival plaque - periodontitis

Tongue – pneumonia

- Worse dental health = pneumonia-associated bacteria

Tongue - pancreatic cancer

- Potential diagnostic tool, since tongue is a part of the GI tract

Environmental factors

Oxygen

- Availability of oxygen changes composition of microbiome

Saliva flow

- determines composition of microbiome at each niche of the oral habitat

Healthy Oral Microbiome

- A “healthy” oral microbiome
  - Difficult to determine over such a wide variety of populations
  - Oral pathogens in Western populations can be healthy in hunter-gatherer societies
  - Type of food and water influence oral microbiome heavily
- Stomatotypes: categories based on dominant bacterial species specifically in the mouth

Oral Diseases

Common oral diseases	Dysbiosis: microbial imbalance	Cancer

• Periodontitis
  • Related to species of the “red complex”
• Dental caries (decay/cavity)
  • High levels of *Stretococcus mutans* in early stages
	• Can lead to health issues, oral and systemic	• Oral cancer
		  • *Capnocytophaga gingivalis*
		• Esophageal cancer
		  • Periodontal pathogens *tannerella forsynthia*

Systemic Diseases

- Oral microbiome is connected to systemic disease
  - Mouth = entry point of ingested material
  - High influence on activity at other body sites
- Systemic diseases
  - Dysbiosis in the mouth and periodontitis are linked to:
    - Many types of cancers (gastric, lung, pancreatic, prostate, breast, and more)
    - Endocrine system disorders
      - Diabetes
    - Cardiovascular disease
    - Neurological disorders
      - Alzheimer’s Disease

Clinical Potential

Oral microbiome has clinical potential

Diagnostics: saliva tests

- Improve early detection of colorectal cancer

Therapeutics: probiotics

- Effective commercial probiotics from gut microbiome can help with dental caries

Current challenges

Distinguishing cause and effect in microbiome studies

Conclusions/ Future Outlook

Key findings

- The oral microbiome plays a vital role in BOTH oral and systemic health

Importance of future research

- Research is still very new and exploratory on this topic
- Continued research is necessary to fully understand the complexities and clinical implications of the oral microbiome
- Improve sequncing
- Very good potential for breakthroughs in diagnostics and therapeutics