THE MICROBIOME AND ORAL HEALTH

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The human body is colonised by a diverse and highly co-evolved community of microorganisms, containing nearly ten times as many cells than there are in the rest of our bodies.[1,2] These microorganisms, colonising our skin, mucosal membranes and teeth, are an integral part of the human organism, and are known to influence human health and disease.

The human body is made up of around ten times more microbial cells than human cells

A COMPLEX ECOLOGICAL COMMUNITY

The collective term for the complex ecological community of commensal, symbiotic and pathogenic microorganisms that colonise our bodies is the **microbiome**.[1]

The human host and its microbiome can be considered a unique evolutionary entity. This so-called "superorganism", which, in addition to our own cells, comprises more than 1,000 microbial species, is the result of millions of years' co-evolution, and expands the gene pool available to our bodies by a factor of 150-to-1. The ways in which these microbial genes interact with the human host determines their ultimate role in our health.[3]

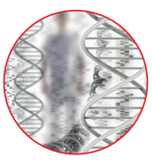
The microbiome is a collection of bacteria, viruses, fungi and other microorganisms that live in and on the human body

THE MICROBIOME AT THE CUTTING EDGE

The function of the microbiome has been debated from the times of Pasteur and Metchnikoff, but until recently little consideration has been given to the effects of microbiome misbalance and its relevance to a wider sphere of disease.[4] Although the human microbiome has long been known to influence human health and disease, we are only just beginning to appreciate the extent of its involvement.[2]

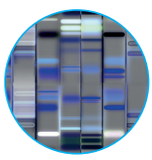
1800s
Connection made between disease and microorganisms

1900s–present
Unculturable microorganisms studied using DNA sequencing



Mid-1600s
First observations of microscopic organisms

1800s–present
Culture, staining and microscopy used to study microorganisms



Early 2000s–present
Human Microbiome Project launched to characterise the human microbiome

In recent years, new research perspectives and technological advances have kick-started a microbiome revolution. Progress has been made in microbiological research, linking approaches focused on pathogens and virulence mechanisms with those examining colonisation, mutualism and effects on host phenotypes.[4] In addition, the recent emergence of new genomic technologies, including modern high-throughput DNA sequencing and bioinformatics tools, has provided a powerful means of understanding the contribution of the human microbiome to health.[2,4]

The future is bright for practical microbiome-based applications that promote human health and treat disease

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A BALANCED MICROBIOME PROTECTS AGAINST DISEASE

As our understanding of the microbiome evolves, it becomes increasingly clear that a balanced microbiome is central to our physiology and health. With functions such as resistance to colonisation by pathogenic microorganisms, stimulation and fine-tuning of the reaction patterns of the immune system, enhanced wound healing and anti-inflammatory properties, it is possible to understand why disease can be a consequence of microbiome disruption.

Recent studies have demonstrated that multiple diseases such as autoimmune diseases, allergies, inflammatory bowel diseases, obesity and certain brain disorders are associated with an imbalance ("dysbiosis") in our commensal microbiota.

The microbiome is central to human physiology and disease

A HEALTHY MICROBIOME IS KEY TO ORAL HEALTH

The mouth is one of the most heavily colonised parts of our bodies, home to a wide range of microorganisms including fungi, viruses and more than 700 bacterial species, which are unique to each individual.[1,5,6] Infants are colonised rapidly after birth, and oral microflora are developed by passive transfer from saliva and the general environment.[6,7]

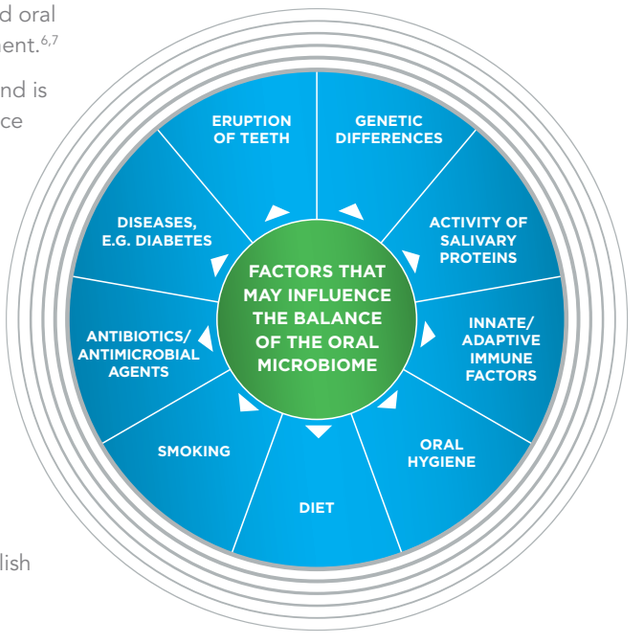
The oral microbiome is essential for maintaining the overall health of the mouth, and is supported and controlled by salivary proteins and enzymes.[5,8] By promoting balance among bacteria in the mouth, the oral microbiome protects against oral disease.[5]

Historical analysis has shown that early humans lived in harmony with their oral microbiota. However, dramatic changes in lifestyle and diet at the time of transition from a hunter-gatherer culture to an agricultural lifestyle, combined with genetic adaptations in microorganisms to this change, has led to dysbiosis, which today results in caries and periodontal diseases.

Investigations have revealed that microbial communities associated with periodontitis differ from those in healthy mouths, and that changes are more often related to a shift in relative numbers of microorganisms, rather than alterations to the species present.[9]

Prevention of oral diseases is therefore progressively moving towards controlling the factors that cause dysbiosis in our relationship with the oral microorganisms, rather than trying to eliminate our oral microbiome. The overall goal is to re-establish the harmonic balance lost due to lifestyle.

Every human mouth contains a personalised microbiome that is essential to maintaining oral health but capable of eliciting disease



SUMMARY

- **The human microbiome refers to the population of numerous and diverse microorganisms in and on the body**
- **The critical and integral role of the microbiome in our health and disease is being increasingly recognised through a rapidly expanding body of research and technology**
- **A balanced microbiome is key to protection against disease, and within the mouth, saliva is responsible for the ecological equilibrium of the oral microbiome**
- **Changes in lifestyle and diet can lead to an imbalance in our microbiome, resulting in disease; therefore, the goal for prevention of oral diseases should be to restore a balanced microbiome**

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