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Bacterial Strains Collected in the Human Oral Microbiome Employed to Trigger Periodontitis in an Experimental Rat Sample

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Introduction

Periodontitis is a prevalent chronic inflammatory disease that affects the supporting structures of the teeth, including the gingiva (gums), periodontal ligament and alveolar bone. This condition is primarily caused by the dysregulation of the oral microbiome, leading to an overgrowth of pathogenic bacteria. Understanding the role of specific bacterial strains in the development and progression of periodontitis is essential for both clinical management and research purposes. In this context, experimental models using animal subjects, such as rats, provide valuable insights into the complex interactions between oral bacteria and host immune responses. This article delves into the intriguing realm of periodontitis research by discussing the collection of bacterial strains from the human oral microbiome for use in triggering periodontitis in an experimental rat sample. Before delving into the experimental aspects, it is crucial to establish a foundation by understanding the human oral microbiome. The human mouth is a diverse microbial ecosystem, housing over 700 different bacterial species. These microorganisms form a complex and dynamic community, which plays a pivotal role in oral health and disease. In a balanced state, the oral microbiome maintains a symbiotic relationship with the host, helping with processes such as digestion and protecting against pathogenic invaders [1].

Description

The composition of the oral microbiome can vary greatly among individuals but generally consists of several predominant phyla, including Firmicutes, Bacteroidetes, Proteobacteria, Actinobacteria and Spirochaetes. Among these, the most extensively studied oral bacteria belong to the phyla Firmicutes and Bacteroidetes, with some well-known genera like Streptococcus, Actinomyces and Porphyromonas. Periodontitis arises when there is a shift in the balance of the oral microbiome, leading to dysbiosis. This shift is characterized by an increase in the abundance of pathogenic bacteria and a decrease in beneficial commensal bacteria. One of the key drivers of this dysbiosis is the accumulation of dental plaque, a biofilm that forms on tooth surfaces. Plaque provides an ideal environment for bacteria to multiply and thrive, ultimately leading to inflammation and tissue destruction in the periodontium. To study the etiology and pathogenesis of periodontitis, researchers often turn to animal models. Rats are a common choice due to their anatomical and physiological similarities to humans, making them suitable for experimental investigations. These models allow scientists to manipulate variables, control environmental factors and collect data that would be challenging or unethical to obtain from human subjects [2].

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In periodontitis research, the choice of experimental animals is a critical decision. Rats are preferred due to their affordability, ease of handling and well-characterized genetics. Various rat strains, such as Wistar, Sprague-Dawley and Fischer, are commonly used in experimental periodontitis studies. Researchers carefully select the strain based on specific research goals and the desired host response. Experimental periodontitis can be induced in rats through various methods, such as ligature placement, chemical irritants, or bacterial inoculation. Ligature-induced periodontitis involves placing a ligature (e.g., silk or dental floss) around the rat's tooth, which promotes plaque accumulation and inflammation. Chemical irritants, like Lipopolysaccharides (LPS), can be injected into the gingival tissues to mimic inflammation. However, one of the most sophisticated and relevant methods is the introduction of human oral microbiome-derived bacterial strains. The use of human oral bacterial strains in rat models presents a unique opportunity to study the role of specific pathogens in periodontitis development. This approach bridges the gap between clinical observations in humans and experimental research in animals. Here, we discuss the steps involved in employing human oral bacterial strains in rat models of periodontitis [3].

The first step is to collect and isolate bacterial strains from human subjects diagnosed with periodontitis. These strains are typically obtained through techniques like saliva sampling, subgingival plaque collection, or Gingival Crevicular Fluid (GCF) collection. Once isolated, these strains are cultured and characterized to identify specific pathogens, such as *P. gingivalis*, *T. forsythia* and *T. denticola*, which are known to be associated with periodontitis. To employ these human-derived bacterial strains, researchers establish a rat model of periodontitis. Rats are anesthetized and surgical procedures are performed to expose the gingival tissues around specific teeth. Human oral bacterial strains are then introduced into the rat's periodontal pockets. These strains are often incorporated into a biofilm or placed in a gel matrix to mimic the natural conditions found in the human oral cavity. Once the bacterial strains are introduced, researchers monitor disease progression over time. This includes assessing clinical parameters such as gingival inflammation, periodontal pocket depth and alveolar bone loss. Various methods, including histological analysis and radiographic imaging, are employed to quantify the extent of tissue damage and bone resorption [4,5].

Conclusion

The use of human oral bacterial strains in rat models of periodontitis has significantly advanced our understanding of the pathogenesis and treatment of this common oral disease. By mimicking the complex interactions between specific pathogens and the host immune system, these models provide valuable insights that bridge the gap between clinical observations and experimental research. However, researchers must remain aware of the challenges and limitations associated with these models and continue to explore innovative approaches to enhance their translational relevance. As our knowledge of the oral microbiome and periodontitis continues to grow, rat models with human oral bacterial strains will play an increasingly vital role in the development of targeted therapies and the improvement of oral health outcomes for individuals worldwide. Conducting experiments with rat models can be resource-intensive, requiring specialized facilities, trained personnel and funding for research supplies and animal care. Maintaining consistency and standardization in experimental procedures can be challenging. Variations in the source and handling of human oral bacterial strains, as well as differences in rat models and experimental protocols, can lead to variability in results.

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Conflict of Interest

There are no conflicts of interest by author.

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