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Advanced immunodiagnostics for periodontal disease: Targeted detection of Kgp and RgpB using A7 and G1 antibody set

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Abstract

Introduction
Periodontal disease, primarily caused by Porphyromonas gingivalis, leads to chronic inflammation and eventual tooth loss, with systemic health implications. Current diagnostic methods rely on clinical assessment, which is insufficiently sensitive for detecting early-stage disease and cannot directly identify specific pathogens or virulence factors. Consequently, developing rapid, sensitive, and specific diagnostic tools targeting key virulence factors such as gingipains (Kgp and RgpB) is critically needed.

Objectives
This study aimed to develop monoclonal antibodies (A7 and G1) specifically targeting Kgp and RgpB for rapid, sensitive, and precise periodontal disease diagnostics using various immunodiagnostic platforms.

Methods
We generated high-affinity monoclonal antibodies through phage display technology, confirmed their specificity via surface plasmon resonance (SPR) and docking simulations, and evaluated their performance across dot blot, enzyme-linked immunosorbent assay (ELISA), colorimetric detection with Au nanoparticles (NPs), and lateral flow assays (LFAs). Clinical validation was conducted on 224 saliva samples from periodontal disease patients and healthy controls.

Results
A7 and G1 antibodies exhibited high specificity and binding affinity to Kgp and RgpB, with equilibrium dissociation constants (KD) ranging from nanomolar to sub-nanomolar. Among the diagnostic methods tested, the LFA demonstrated outstanding performance, accurately detecting Kgp and RgpB at picomolar levels, while the Au NP-based assay enabled successful visual detection. Clinical validation of the LFA showed remarkable sensitivity of 99.2% and specificity of 100%, effectively distinguishing patients from controls.

Conclusion
The developed A7 and G1 antibody-based LFA represents a significant advancement in periodontal disease diagnostics. Offering rapid, accurate, and sensitive detection directly from saliva samples, this method holds great promise for clinical use, facilitating early diagnosis and timely intervention to improve patient outcomes.

논문정보

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