ABSTRACT

Tunç Botello Becerra, İ. (2006). Finite Element Analysis of the Effects of Different Abutment Systems on Biomechanical Stress and Implant Components. Istanbul University, Institute of Health Science, Department of Oral Implantology. PhD Thesis. Istanbul.

This study aimed to analyze the biomechanics of three abutment systems with distinct retention mechanisms and their impact on the implant–abutment interface. The finite element analysis method was used to model maxillary three-unit restorations with conventional cement-retained abutment, multi-unit abutment, and innovative cementless link-retained abutment systems. Dental implants were positioned at 0°/0°, 0°/15°, 0°/25°, 15°/15°, and 25°/25° angulation combinations. Analyses were performed under 400 N vertical and 200 N oblique loading applied at a 45° angulation. The link-retained abutment system exhibited lower stress on the implants and abutments under both loading conditions, whereas the cement-retained abutment system demonstrated the highest stress. In contrast, the maximum and minimum principal stresses within the peri-implant bone were the highest in the link-retained system under oblique loading conditions. Despite greater microgap formation in the molar region, no specific abutment system exhibited a distinct superiority under different scenarios. Overall, an increase in implant angulation led to higher stress values across all parameters. The multi-unit and link abutment systems demonstrated reduced stress concentration and more uniform load distribution compared with the cement-retained system under tilted implant configurations. The findings suggest that the innovative cementless link-retained abutment system may serve as a feasible alternative to conventional cement-retained and multi-unit abutment systems, exhibiting superior biomechanical performance under specific conditions, particularly compared with the cement-retained abutment system.

Key Words: abutment; angulated; cementless; dental implant; finite element analysis; microgap

The present work was supported by the Research Fund of Istanbul University. Project No. TDK-2024-41430