

## Material Characteristics of Dental Implant System with In-Vitro Mastication Loading

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**초 록:** A dynamic fatigue characteristic of dental implant system has been evaluated with applying single axial compressive shear loading based on the ISO 14801 standard. For the advanced dynamic fatigue test, multi-directional force and motion needed to be accompanied for more information of mechanical properties as based on mastication in oral environment.

In this study, we have prepared loading and motion protocol for the multi-directional fatigue test of dental implant system with single (Apical/Occlusal; AO), and additional mastication motion (Lingual/Facial; LF, Mesial/Distal; MD). As following the prepared protocol (with modification of ISO 14801), fatigue test was conducted to verify the worst case results for the development of highly stabilized dental implant system.

Mechanical testing was performed using an universal testing machine (MTS Bionix 858, MN, USA) for static compression and single directional loading fatigue, while the multi-directional loading was performed with joint simulator (ADL-Force 5, MA, USA) under load control. Basically, all mechanical test was performed according to the ISO 14801:2016 standard. Static compression test was performed to identify the maximum fracture force with loading speed of 1.0 mm/min. A dynamic fatigue test was performed with 40 % value of maximum fracture force and 5 Hz loading frequency. A single directional fatigue test was performed with only apical/occlusal (AO) force application, while multi directional fatigue tests were applied 2° of facial/lingual (FL) or mesial/distal (MD) movement.

Fatigue failure cycles were entirely different between applying single-directional loading and multi-directional loading. As a comparison of these loading factor, the failure cycle was around 5 times lower than single-directional loading while applied multi-directional loading. Also, the displacement change with accumulated multi-directional fatigue cycles was higher than that of single directional cycles.

### References

- Las Casas, E. B. D., Almeida, A. F. D., Cimini Junior, C. A., Gomes, P. D. T. V., Cornacchia, T. P. M., & Saffar, J. M. E. (2007). Determination of tangential and normal components of oral forces. *Journal of Applied Oral Science*, 15(1), 70-76.
- Gal, J. A., Gallo, L. M., Palla, S., Murray, G., & Klineberg, I. (2004). Analysis of human mandibular mechanics based on screw theory and in vivo data. *Journal of biomechanics*, 37(9), 1405-1412.
- International Standard. (2016). International standard test for endosseous dental implant.

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