Comparison of bio-mechanical evaluation methods by insertion torque up to 100Ncm

Nagata Mutsumi[1)], Nagata Mizuki[2)], Kanie Takahito[1)], Kikuchi Masafumi[1)]

[1)]Dpt. Biomaterial Science, Field of Oral and Maxillofacial Rehabilitation, Kagoshima University.

[2)]Dpt. Periodontology, Graduate School of Medical and Dental Science, Tokyo Medical and Dental University.

Background: Measurement of Insertion torque(ITq), Resonance frequency analysis(RFA) evaluated by the ISQ(ISQV), and implant mobility by the Periotest (PT) are used to assess improvements in the implant treatment. Concerning these assessment values, various findings were reported. However, they are somewhat equivocal about the value and correlation of these tests to the degree of osseointegration, and there is no clear consensus as to when an implant achieves a minimum degree of stability to allow restoration into functional loading.

To achieve good primary stability, more than 20 to 30Ncm of ITV has been recommended. On the contrary, it has been postulated that high ITqV can lead to osseous necrosis due to ITqV higher than 40 to 45Ncm. Therefore higher ITqV has not been recommended. Although these concepts are widely accepted, Trisi denied compression necrosis of the bone through his goat experiment. Implant outcome under high torque installation is a controversial issue.

Aim/Hypothesis: Monitoring the stability of the implant is key to implant treatment success. Assessment of high level bio-mechanical parameters in humans has not been commonly performed. Assessment and comparison of ITqV, ISQV, and PT-value(PTV) data were performed, using a new measurement device, which can detect insertion torque up to 100Ncm.

Materials & methods: 167 dental implants of one-stage procedure (SwissPlus, Zimmer, USA) were tested. ITqV was assessed by the Torque-Lock(Intra-Lock) and Torque-Meter(Inplatex), RFA was detected by the Osstell™ Mentor(Integration Diagnostic AB), and PTV was measured by the Periotest(Gulden). Statistical analysis was made by the one-way ANOVA and Tukey's test.

Results: All fixtures were successfully treated. The averages of ITqV, ISQV, and PTV were, 46.4Ncm, 72.3ISQ, -5.3PTV respectively. ITqV results were divided into 3 groups: low; less than 25Ncm(n=14, av.=12,3), middle; less than 50Ncm(n=57, av.=36,0),high;over 50Ncm(n=96, av.=78.8), ISQV of the 3 groups increased from 67.0 to 79.8 in average, and showed a strong correlation(r=0.49). Correlation of PTV between the low vs high group, and the middle vs high group was also observed(r=-0.34), whilst the low vs middle group showed no correlation.

Conclusion and Clinical implications: All the dental implants installed under high torque achieved success. Within the limitation of this study, these three bio-mechanical measuring devices showed a strong correlation. The possible usefulness of this overall bio-mechanical data with regard to judgement of when to start loading became apparent.