Early detection of implant healing process using resonance frequency analysis

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Abstract

In this study, in vitro and in vivo models were adopted for assessing the application of resonance frequency analysis (RFA) in the early detection of implant stability. In the in vitro tests, RF values of implants placed in bone block with predrilled cavities of 3.75 and 5.0 mm were measured and compared. Stone was used to fill the inter-space between implants and the bone blocks. Our results showed that poor initial stability conditions contributed to a lower initial RF (IRF) value (5.41+/-0.32 kHz) and a longer simulated healing period (41 min) than that of well-fitted conditions (9.63+/-0.34 kHz for IRF, 14 min for the simulated healing period, $P<0.05$). To validate such in vitro tests, animal models were also performed. Implants were placed in the left tibias of six rabbits using a general surgery procedure. The modal testing method was used to test the RF values of the implants. The RF values of the implants increased significantly ($P<0.05$) during the healing period and reached a plateau when the implant-bone interface was united. The variations of RF values of the testing implants showed a similar trend to the results of in vitro tests, i.e., implants with higher initial RF values had shorter simulated healing times. Based on these findings, we concluded that RFA is a reliable and accurate method for early assessment of the osseointegration process.