Stimulation of Directed Bone Growth on Oxidized Titanium Implants by Surface Modification: An In Vivo Study

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Abstract: The strength of osseointegration is considered an important parameter in assessment of the performance of dental implants especially in immediate loading protocols. It has been demonstrated that surface alteration may enhance performance. This investigation measures the rate of osseointegration, removal torque values and the implant stability of surface modified implants *in-vivo*.

Introduction

The influence of surface topography at the micrometer level on bone integration and the stability of dental implants has been studied extensively. However, less is known about the interrelationship between surface treatments on bone formation around dental implants. The present in vivo investigation was undertaken to study if bone formation and implant stability were influenced by modified blasting and etching techniques on the flange and thread flank of oxidized titanium implants.

Materials and Methods

Grade 4, commercially pure titanium implants were manufactured. They were blasted with an inert media, acid etched, cleaned using a proprietary cleaning technique and immediately stored in hermetically sealed glass transport packaging. Eighteen rabbits and oxidized titanium implants (4.0 mm in diameter and 7 mm long) were used in the study. The rabbits received three control (blasted) implants and three test (blasted and etched) implants.

The animals were followed for 10 days, 3 and 6 weeks. Removal torque (RTQ) tests were applied to three of the implants in each leg. The remaining implant per leg was retrieved for histology. Implant stability measurements using Resonance Frequency Anlaysis (ISQ) measurements were made for each implant at placement,10 days, 3 and 6 weeks.

Results

The RTQ tests showed that the peak RTQ was higher for the test than control implants by approximately 70% at 10 days, 105% at 3 weeks. The difference in RTQ was statistically significant ($P<0.05$) at 10 days and three weeks.

Implant stability measured using RFA demonstrated increasing stability for both test and control groups. There was no significant differences in ISQ between test and control groups. However all groups demonstrated a mean increase in ISQ over 6 weeks of 20 ISQ.

Conclusions

- It is concluded that an etched and blasted implant surface stimulates bone to form more rapidly and with a greater strength at the implant interface than for a blasted surface alone.
- It is suggested that implants with such a surface may be one way to optimize implant stability and osseointegration for implants used in immediate and early loading protocols.

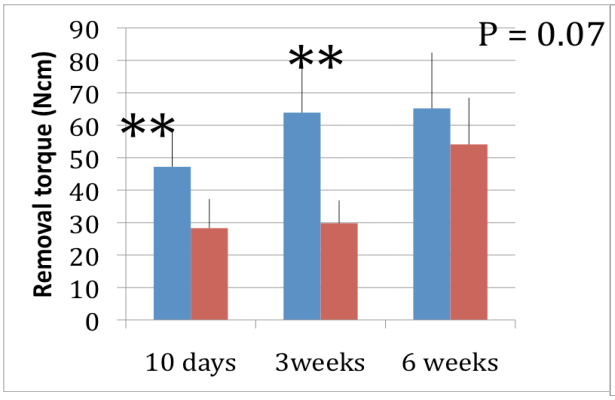

Figure 1.
Removal torque values for tibial implants at 10 days, 3 and 6 weeks comparing test (blue, etched and blasted) with control (blasted only orange) implants

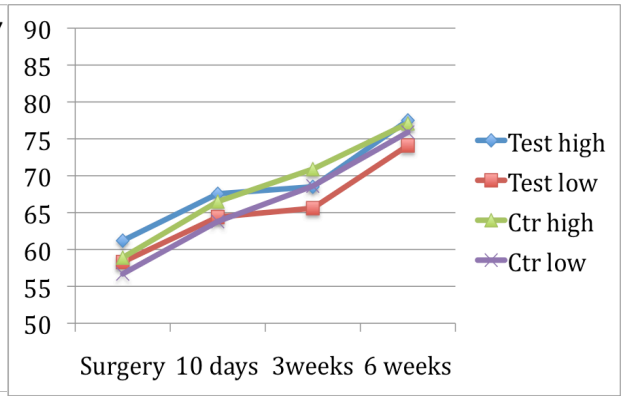

Figure 2. Mean Implant stability (ISQ) measurements for test and control implants at placement and after 10 days, 3 and 6 weeks.