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Histological analysis of implants subjected to immediate functional loading in single tooth replacement

Analisi istologica di impianti soggetti a carico funzionale immediato nella riabilitazione del dente singolo

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Summary

Human histology was used to evaluate the effect of immediate load on bone healing to implants. The results showed that while no significant differences in BIC % were found between immediate loading implants and controls, the percentage area of the wowen bone was significantly larger around test than control implants. It is suggested that immediate loading of implants does not influence osseointegration.

Riassunto

Il presente studio istologico umano è stato eseguito per valutare l'effetto del carico funzionale immediato sulla guarigione ossea degli impianti. I risultati non hanno evidenziato differenze statisticamente significative in termini di percentuale di osso a contatto con la superficie implantare (BIC%). La densità di nuovo osso formato è risultata maggiore intorno agli impianti sottoposti a carico immediato piuttosto che intorno agli impianti controllo.

Introduction

Immediate functional loading of implants is an obvious advantage, especially in anterior regions when the need to restore the aesthetic appearance after tooth loss has a high priority. In the last years an increasing concern regarding the possibility to shorten the healing period of time in cases of single tooth replacement has became evident. Several studies (Malò et al. 2003, Glauser et al 2005, Lindeboom et al. 2006, Donati et al. 2008) reported a success rate between 100% and 91% after one year follow up of implants immediately loaded in a single tooth replacement. Although some case-reports (Testori et al. 2002, Rocci et al. 2003, Degidi et al. 2009) described human histological findings of immediate loading implants, it is not known whether immediate loading affects the osseointegration process. The objective of the present study was to evaluate the effect of immediate loading on bone healing to implants using human histology.

Material & Methods

Thirteen subjects, who required double single tooth rehabilitation were enrolled. A total of 11 males and 2 females, mean age 53.8 (SD 9.6) participated to the study. All subjects received two single implants each; 1 immediately loaded (test) and 1 not loaded (control) implant. Biopsies containing the implant and a narrow zone (0.7-0.8 mm) of the surrounding bone were collected using a trephine drill after 1 month in 9 patients and after 3 months in 4 patients. The biopsies were processed for ground sectioning and prepared for histological analysis including the degree of bone-to-implant contact (BIC %) and the percentage area of the peri-implant tissues occupied by lamellar bone and woven bone.

The local human review board approved the study protocol and prior to enrollment all subjects received the information regarding the purpose of the study and signed an informed consent.

Results

Three implants subjected to immediate load failed to integrate, 2 in the 1-month and 1 in the 3-month healing group. Analysis using a multilevel multivariate statistical model (Table 1 and 2) demonstrated that while no significant differences in BIC % were found between test and control implants, the percentage area of the wowen bone was significantly larger around test than control implants at 1 and 3 months of healing. The analysis also revealed a significant variability between subjects regarding BIC %. All subjects participating to the study were at the end of the trial restored according to the treatment plan scheduled and restorations met their expectations. All procedures were carried out uneventfully.

Analysis using a multilevel multivariate statistical model

Table 1. BIC% at test and control implants after 1 and 3 months of healing

BIC %	Test		Control	
	1	3	1	3
Micro-thread all bone (%)	26.4 ± 7.7	44.7 ± 10.3	30.8 ± 7.4	49.1 ± 10.5
Micro-thread new bone (%)	25.7± 8.6	41.5 ± 12.5	24.6 ± 8.3	40.2 ± 12.3
Macro-thread all bone (%)	31.2 ± 10.5	49 ± 14.7	30.1 ± 10.1	48.2 ± 15.3
Macro-thread new bone (%)	29 ± 10.8	45.9 ± 15.9	25.2 ± 10.5	42.1 ± 15.7

Micro-thread = micro-threaded portion of the implant
Macro-thread = macro-threaded portion of the implant
All bone = woven bone and lamellar bone
New bone = woven bone
Lower level unit: section
Mean values ± 95% CI

Sections of biopsies representing implants retrieved after 1 month of healing. Immediate loaded implant at left side and control implant at right side.

Table 2. Newly formed bone density at test and control implants after 1 and 3 months healing

BONE DENSITY %	Test		Control	
	1	3	1	3
Micro-thread new	16.7 ± 4.4	25.3 ± 6.4	11.4 ± 4.3	20 ± 6.3
Macro-thread new	17.4 ± 3.3	19.6 ± 4.8	11.9 ± 3.1	14 ± 4.8
Chamber new	22.3 ± 4.9	28.7 ± 7.2	13.4 ± 4.8	19.8 ± 7.1

Chamber = area within macro-threads
Macro-threads = area outside macro-threads
Micro-threads = area outside micro-threads
Lower level unit: section
Mean values ± 95% CI

Discussion

The present investigation was accomplished to study the effect of immediate load on bone healing to implants using human histology. There is limited information concerning human histology in relation to immediate functional loading implants. Testori et al. (2002) retrieved two submerged and one immediate loaded implants after two months. The bone-to-implant contact was 38.9% and 64.2% for the submerged and the immediate loaded implants respectively. Rocci et al. (2003) performed a histological analysis on 2 implants subjected to immediate loading and 7 controls. The implants were retrieved after 9 months and the histological analysis revealed that the percentage of bone-to-implant contact was 92% and 81% respectively. Degidi et al. (2009) installed 4 implants (2 test and 2 controls) in 4 different subjects. Two implants (1 test and 1 control) were retrieved after 1 month and two implants were retrieved after 2 months. It was observed that after 1 month healing the BIC% was 65.6% and 54.7% and after 2 months was 76.2% and 62.3% for test and control implants respectively. The present study was designed as an intra-individual controlled trial and is, to our knowledge, the first controlled human histological study on immediate functional loading implants used in a single tooth replacement. It was observed that immediate loading of implants does not influence the degree of the osseointegration process (i.e. BIC%), but the density of newly formed peri-implant bone at such sites appears to be increased in relation to unloaded control implants. A significant variability between subjects regarding the BIC% was also revealed.

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