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Laser Surface Modification of Biomedical Ti-Mo Alloys: an *in vivo* study

N.T.C. Oliveira[1*], V. Perroti[2], H.S.Tavares[1], F.P.S. Guastaldi[1], G. Iezzi[2], A. Piattelli[2], A.C. Guastaldi[1]

(1) Grupo de Biomateriais, IQ – UNESP Araraquara - SP, Brazil - P.o.Box 355. E-mail: ntco@yahoo.com
(2) Department of Stomatology, University of Chieti-Pescara, Chieti, Italy. E-mail: apiattelli@iunich.it
* Corresponding author.

Abstract – Ti-15Mo alloy cylindrical implants were obtained the authors and divided into two groups: machine-surfaced (control) and surface modification by Laser beam-irradiation (test). After 12 weeks of implantation in rabbits, the implants were processed for histology and histomorphometric analysis. A direct contact between bone and implant surface was present only in very few areas for machined implants, while in laser implants the bone tissue perfectly filled the surface irregularities, without a gap at the bone-implant interface. Histomorphometrical data showed a significant statistical difference between control and test groups regarding the bone-to-implant-contact percentage. The results suggest that Ti-15Mo alloy with laser treated surface are promising for implant application.

Introduction: It has been demonstrated that Ti-Mo alloys are promising materials for implants due their electrochemical stability and low Young's modulus [1,2]. However, the topography of the implant surface is as important as its composition in order to improve osseointegration. Laser beams irradiation has been proposed as novel and clean process for surface topography modification [3]. The goal of this work was to histologically evaluate the bone response to recently developed Ti-15Mo alloy with two different implant topographies (machined and laser) in a rabbit model.

Materials and Methods: The Ti-15Mo wt.% alloy was prepared and characterized by the authors following a procedure described at the literature [1]. A total of 20 wide cylindrical implants (4.0 × 10.0mm) were obtained from the alloy ingots, and divided into two groups, one (control) machine-surfaced and other (test) with surface modification by Laser beam-irradiation. After a 12 weeks of implantation in rabbits, the implants were processed for histology and histomorphometric analysis [4]. Data from the histomorphometrical evaluations were analyzed using the nonparametric paired Mann-Whitney Test.

Results and discussion: SEM analysis showed the control group with a smooth surface (Fig.1a), while test group presented irregular shaped cavities on their surface (Fig.1b). Histological evaluation showed in the cortical region along implant perimeter, compact bone tissue with small marrow spaces in both machined and laser-treated surfaces. However, a direct contact between bone and implant surface was present only in very few areas for machined implants (Fig 2a), while in laser-treated implants the bone tissue perfectly filled the surface irregularities, without a gap at the bone-implant interface(Fig. 2b). Histomorphometrical data showed a significant statistical difference between control and test groups regarding the bone-to-implant-contact percentage (BIC%): 24.04% and 41,88% respectively ($p = 0.0012$).

(a)

(b)

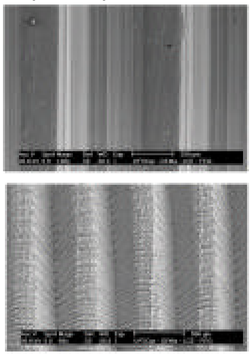

Figure 1: SEM micrographies showing the topography of Ti-15Mo alloy implants with (a) machined and (b) laser beam-irradiated surfaces. 100x.

(a)

(b)

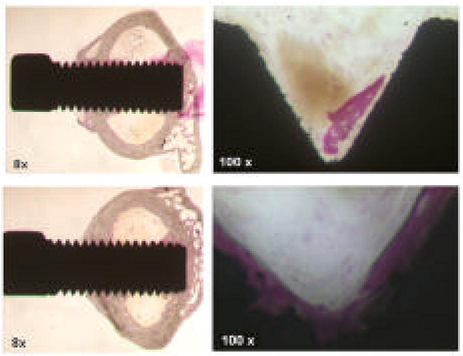

Figure 2: Light microscopic pictures of Ti-15Mo alloy with (a) Machine-surfaced (control group) and (b) implant with Laser beam-irradiated surface (test group). Whole implant (8x) and space between the threads (100x).

Conclusions: These results suggest that Ti-15Mo alloy with laser treated surface are promising for implant application.

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