Relationship between the Initial Cell Morphology and the Surface Texture of Ti discs

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Introduction : Many techniques for surface modification such as grit blasting, anodizing and chemical etching have been applied to improve the fixation and osseointegration of metallic implants with surrounding bone tissue in a human body, Among the techniques, grit-blasting method has widely used due to relatively easy process and feasibility for the surface treatment of dental implants. In this study, a scratching method was applied for the surface modification of dental implants. The effects of various surface textures created by polishing, blasting, and scratching was examined and compared in terms of cell attachment and morphology and proliferation.

Methods: The three types (surface polished, blasted and scratched) of cp-Ti disk specimens were prepared by mechanical surface treatments, i.e., polished, blasted and scratched. The polished samples were prepared using a series of SIC polishing papers (#400, 800, 1200, and 2000). The blasted disks were prepared using 150 and 250μm HA (hydroxyapatite) grit sizes. And the scratched specimens were produced by hand scratching with about 14.7 N using SIC polishing papers (#400, 800, 1200, and 1500). Mesenchymal stem cells (MSC) were isolated from aspirated iliac crest of normal human donors and cultivated with DMED-LG containing 10% FBS. In order to examine the MSC behaviors on cp-Ti disks, second passage cells were seeded on the cp-Ti disks with density of 1.2×10^4 cells/cm^2 and analyzed at 2 hrs, 1 day, and 1 week. Harvested disks were fixed in formaldehyde and double stained with 500 U/ml phalloidin-FITC and 100 nM/ml DAPI. Nine random fields were selected and actin fibers and nuclei were imaged by fluorescence microscope. Nuclei of each field were quantified with aid of image analysis program. SEM observation of the samples was also recorded. Total 325 disks, 2925 fields were analyzed in the experiment.

Results: The morphology of the cells on three types of cp-Ti disks was quite different according to the surface treatment methods. Cells on polished and blasted disks showed well spreading and isotropic arrangement. The surface roughness of blasted disks was not significantly affected to the cell arrangement, but the rougher surface showed the slightly better cell proliferation at 1 week. However, the cell attaching behavior on the unidirectional scratched disks showed the very different pattern. The unidirectional cell arrangement was parallel to the scratched direction on entire surface.
The number of the cells on disks with various surface treatments was similar at 2 hrs and 1 day, but the blasted group showed the higher than scratched group and significantly higher than the polished group (control) at 1 week ($P<0.05$).

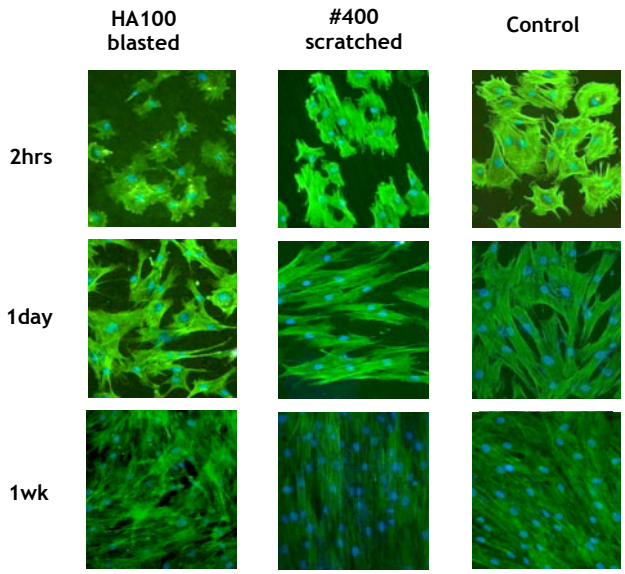

Figure 1. Fluorescent images of MSC cultured for 2 hrs, 1 day and 1 week on blasted, scratched and polished (control) samples.

Conclusions:
1. Cell morphology on cp-Ti disks was quite different according to the surface treatment methods. After 1 day, cells on polished and blasted disks showed well spreading and isotropic arrangement. However, the unidirectional scratched samples showed the anisotropic cell arrangement, which was parallel to the scratched direction.
2. Surface roughness generated by blasting and scratching methods did not significantly affected to the cell proliferation, but the rougher surface showed the slightly better cell proliferation at 1 week.
3. The number of the cells on disks with various surface treatments was similar at the early stage (2 hrs and 1 day), but the blasted group showed the slightly higher than scratched group and significantly higher than the polished group (control) at 1 week.

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