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2008 Titanium Surface Treatments and Growth of Human Mesenchyamal Stem Cells

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Objectives: Different titanium surface treatments influence the interaction of stem cells on the implant surface. This study evaluated the effect of different surface roughness of titanium on the growth of human bone marrow derived mesenchymal stem cells (MSCs). Methods: Human MSCs are derived from bone marrow (BM) of normal healthy donors. Human neuroblastoma cells were used as a contorl. The proliferation of MSCs and neuroblastoma cells on titanium disks of different surface roughness (6 groups: smooth, laser-treated, sandblasted with 25-, 50-, 110-, 250-μm alumina particle respectively) under either a 3-day or a prolonged 7-day was evaluated by XTT assay. The growth pattern was examined under confocal laser scanning microscope at day-7 and day-12. Results: The most optimal proliferation of MSC as measured by XTT was those titanium surface sandblasted with 50 μm of alumina particles. Suggesting intermediate pore size is better than either small (25-μm) or large (110 & 250-μm) pore sizes. The confocal laser scanning microscopy showed the MSCs grew in a polymorphic shape and spread along the ridges of the sandblasted titanium surface while that of neuroblastoma cells remained round and unchanged. MSCs reached confluent growth at Day 12 and covered the entire titanium surface including the small & intermediate pores (but not large pores) as a single layer whereas neuroblastoma cells formed confluent growth as a 3-4 overlapping layers. Interestingly, laser-treated titanium surface inhibited the proliferation of both MSCs and neuroblastoma cells. Conclusion: There are differences in the proliferation rate of MSCs on various titanium surface roughness and we found that surface sandblasted with 50 μm of alumina particles yielded the most optimal growth pattern for MSCs. The method of inducing surface roughness (sandblasting vs laser) can also influence the growth of MSCs. The financial assistance of a CRCG research grant, HKU is gratefully acknowledged.