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The Effect of Different Size Wear Particles on Osteoblasts and Osteoclast Function

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1 Introduction

The objective of this paper was to study the mechanisms for the effect of different size titanium particles loading on osteoblasts and osteoclasts' function *in vitro*, in order to find the mechanisms in peri-prosthetic loosening.

2 Materials and Methods

Rabbit osteoblasts were loaded with circular Titanium particles having three different mean diameters, 0.9, 2.7, and 6.9 µm, at three different concentrations, 0.25, 0.1, 0.05wt% for six different durations, 4, 8, 12, 24, 36 and 48 h, respectively. Unloaded osteoblasts were used as a control. Following Titanium particles loading, conditioned media(OB-CM) harvested from osteoblasts culture system in the indicated duration was added to the rabbit osteoclasts culture system for 3 days. The net impacts of conditioned media on osteoclastic function were examined through adopting tartrate-resistant acid phosphatase (TRAP) positive cells count, resorption pit area, cytoskeleton, concentration of C-telopeptide of type-I collagen (CTx) and intracellular Ca^{2+} concentration.

3 Results

The present study showed that (1) three size titanium particle loadings, especially 0.9 µm (submicron), obviously suppressed differentiation and mineralization ability of osteoblasts (**Fig. 1**). While 2.7 µm and 6.9 µm particles, especially the latter, mainly enhanced osteoblasts to product bone resorption factors, whose response was slow and intensive. (2) Three of OB-CM (co-cultured media from osteoblasts and titanium particles) enhanced osteoclasts' differentiation , maturation, While 2.7 µm and 6.9 µm, especially 6.9 µm OB-CM , significantly augmented maturation and survival of osteoclasts , the extent more than that the 0.9 µm OB-CM (**Figs. 2, 3**).

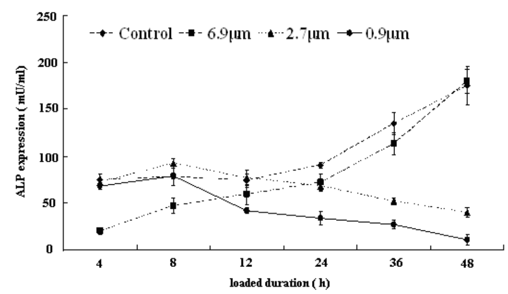

Figure 1 : Effects of 0.1wt% titanium particles loading on ALP expression of osteoblasts (n = 6, $\bar{x} \pm s$).

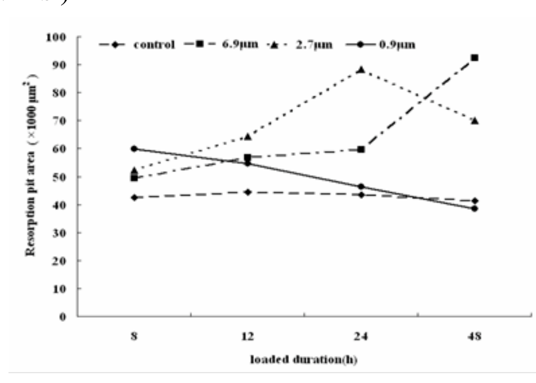

Figure 2 : Effect of OB-CM on the area of resorption pits(n =6, $\bar{x} \pm s$)

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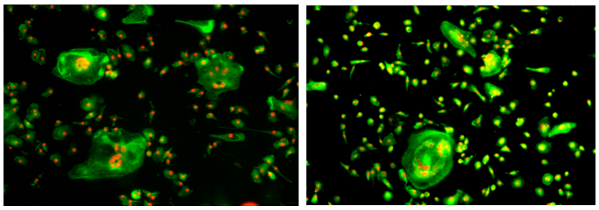

Figure 3 : Comparion of OB-CM on the cytoskeleton of osteoclasts by immunofluorescence test. Left: 6.9 μm OB-CM group; Right: 0.9 μm OB-CM group. Green fluorescent: F-actin marked by BODIPY® FL phallacidin dye (Molecular Probes); Red fluorescent: dsDNA marked by BOBO-3 dye (Molecular Probes).

4 Conclusion

The results suggested that during periprosthetic loosening occurred, submicron wear particles would inhibit periprosthetic osteogenesis while bigger wear particles would augment periprosthetic osteolysis, arouse the imbalance of the coupling mechanism of bone formation and bone resorption, ultimately cause the net bone loss around the bone-prosthesis microenviroment.