The success rate of titanium-alloy mini implant screws (MIs) is only 75%, mostly due to breakage during loading and lack of osseointegration. Lack of osseointegration can be attributed to the combined activity of osteoclasts (OCs) and osteoblasts (OBs) in the remodeling process that occurs around MIs after implantation. A potential replacement material, stainless steel (SS), has increased stiffness and loading strength, but its osteogenic properties have not been well established. A promising method of increasing osseointegration is using bone morphogenic protein-2 (BMP-2), which is widely known to increase OB differentiation and cause bone growth, to coat the implant. The objective of this study is to explore the effect of SS and titanium MIs, along with BMP-2, on OB and OC differentiation in vitro. We hypothesize that both metals will inhibit OC differentiation when compared to a negative control, that the metals will have a negligible effect on OB activity, and that BMP-2 will greatly increase OB differentiation but have little effect on OC activity. To assess the effects of the metals and BMP-2 on OC activity, OC precursors were isolated from the bone marrow of C57/bl6 mice and differentiated for 7 days in the presence of 150µm thick sections of either SS or titanium MIs and three different concentrations of BMP-2 (2ng/mL, 5ng/mL, or 10ng/mL). On day 7, each plate was stained for tartrate-resistant acid phosphatase, a marker of mature osteoclasts, and OC number was counted. OB precursors were isolated from the calvaria of 3-day-old mouse neonates and differentiated for 7 days in the presence of each metal MI and BMP-2. OB activity was determining using a qualitative alkaline phosphatase activity assay (a marker of mature OBs). Our studies reveal OB differentiation was unaffected by the presence of either SS or titanium metals, while OC activity was significantly inhibited by SS but not greatly affected by titanium. Our findings also confirm the osteogenic effect of BMP-2 on OB activity, and demonstrate that BMP-2 has little effect on OC activity. These findings suggest that metals made of SS may offer greater long-term stability than titanium implants due to decreased OC activity. Moreover, SS MIs coated with BMP-2 may be more stable in vivo because of increased OB-mediated osseointegration around the implant.
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