Do Titanium Particles Cause Bone Loss Around Dental Implants?

Bone loss around dental implants leads to implant failure

Is bone loss triggered by leakage of titanium (Ti) particles from the implant, and if so, what is the mechanism?

Bone loss

Ti implanted in Sprague Dawley rats

Analysis of implants

Ti particles + clodronate

Ti particles + PBS

Ti particles + empty liposomes

PBS control

Bone loss

Ti increases inflammatory M1 macrophages, pro-inflammatory cytokines, and bone loss

Titanium particles from dental implants activate macrophages that cause inflammatory reactions resulting in bone loss and implant failure

Inflammatory cytokines and bone loss induced by Ti particles were reduced upon depletion of macrophages by clodronate
Titanium particles from dental implants activate macrophages that cause inflammatory reactions resulting in bone loss and implant failure.
Ti increases number of inflammatory macrophages

Clodronate reduces production of inflammatory cytokines in bone caused by Ti

Titanium particles from dental implants activate macrophages that cause inflammatory reactions resulting in bone loss and implant failure