Surface Matters: Nanotechnology in Orthopaedics and Spine

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Implant surface geometry is important for biological response from surrounding tissue smooth surface to rough to nano-surface have variable response – from cellular and protein adsorption and bony integration, as one changes surface from macro to micro to nano. For stability at bone implant or bone on bone (fracture or graft healing). The surface is important consideration which is modified through osteo-immune cells – macrophages M1&M2 which help in bio-debridement then restore the bone biology and continuity.

Nanotechnology in orthopedics is hot and emerging topic for research and development. Implants as Total Hip Replacement /Total Knee Replacement etc. are now increasingly by coated with nanomaterial as Titanium (Ti) and Hydroxyapatite (HA) which result in better bondage, integration with host bone thus increasing stability and longevity of implant, thus reducing long term complications of loosening etc.

Keywords: Implant surface geometry, Implant surface geometry Total Knee Replacement, nanomaterial, Titanium, Hydroxyapatite

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Infections in orthopedics/spine surgery is sometime difficult to treat-nano loading of cells with antibiotics helps in delivery which is further helped by increased surface area through nano-engineering. Same phenomena help in oncological management at cellular level.

Fracture management / healing is helped apart from input from immune response in which macrophage activity expose nano-surface at fracture site thus initiating a biological response which fill up the gap – by cellular and protein adsorption and expression of osteoblastic activity.

Same nano-surface treatment in spinal cage (Polyether-ether-ketone cage) and spacer induce and bio-cellular activity which results in cellular attachment expression of various growth factors and provision robust-bond at bone implant interface thus eliminates any motion.

In areas of bone/cartilage deficiency 3-D printed implants are now being developed utilizing various bio-inks and proteins helping in taking care of bone and cartilage defects and in trauma, infective bone loss, ortho-oncology and other situations by providing viable, implantable scaffolds which biologically active nano-surface.

In summary nano technology is exciting new field in orthopedic and spine offering durable bioactive solutions which hitherto has been difficult to tackle.

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