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Clay nanotubes as growth factor delivery vehicle for bone tissue formation

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A wide variety of natural and synthetic materials (and combinations) have been used to bioengineer bone tissue. Growth factors have been supplied to progenitor cells in various forms to trigger a series of metabolic pathways leading to cellular proliferation, differentiation and functionality. The challenge is to supply these proteins, in the range of nano or even picograms, and in a sustained fashion over a period of time. Such a delivery system has yet to be developed. Alginate hydrogels are widely used to as a drug delivery system. We used halloysite nanotubes (HNTs) as carriers for the delivery of BMPs 2, 4 and 6, singly and in combination. Growth factors were vacuum loaded into HNTs and doped HNTs added to osteoblast-seeded alginate hydrogels. Cell proliferation, functionality and mineralization were observed over a 21-day period. Controls had unloaded HNTs dispersed within the alginate hydrogel. Halloysite nanoparticles showed a sustained release of all BMPs over a 21-day period with the dosage in picograms per milliliter. Increased collagen deposition, bone protein expression and formation of a mineralized matrix were observed that increased over the 21-day period. There was an increase in hydrogel material properties. Osteoblast proliferation, bone protein expression and mineralization in control cultures were reduced in comparison to experimental cultures. The data supports the potential use of a hydrogel-growth-factor doped HNT system as part of a novel osteogenic system that can deliver growth factors to the injured site (fracture, bone loss) and assist in bone repair.

Biography

David K. Mills received his Ph.D. in 1990 from the University of Illinois and joined the faculty at Louisiana Tech University in 1994. He holds a joint faculty appointment in the Center for Biomedical Engineering and Rehabilitation Science and the School of Biological Sciences. He has over 50 papers published in national and international and has directed over 80 MS and Ph.D. students in the fields of Biology, Biomedical Engineering, Chemical Engineering and Molecular Science and Nanotechnology. He is President of Organic Nano, a Louisiana company focused on the development and commercializing halloysite nanotube technology and bioactive polyelectrolyte multi-composite nanocoatings.

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