Nanotechnology and orthopedics: an imperative bond

OLIVIA GRAY

Editorial Office, Journal of Orthopaedics Trauma Surgery and Related Research, Poland

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Address for correspondence:

Olivia Gray, Editorial Office, Journal of Orthopaedics Trauma Surgery and Related Research, Poland; Email: Olivia_g@yahoo.co.in

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Abstract

Nanotechnology has a wide range of innovative uses, including the use of nanoparticles as scaffolds to improve the interface between orthopaedic implants and native bone. Nanotechnology has the potential to transform orthopaedic surgery diagnosis and treatment, however the long-term health implications of nanomaterials are little understood, and further study on clinical safety is needed. Nanotechnology is a relatively newcomer to orthopaedic research, diagnostics, and treatment. It has been able to change the science and practise of orthopaedic care in the short period it has been studied and utilised. Many conventional therapies are being replaced, as nanotechnology provides ways to treat the human body in ways that are more precise, better for bone growth, and theoretically safer, at least in terms of infection rates and necessity of re-operations

INTRODUCTION

The application of nanotechnology in medicine, particularly in the field of orthopaedics, is a hot topic of debate. Nanotechnology has a wide range of innovative uses, including the use of nanoparticles as scaffolds to improve the interface between orthopaedic implants and native bone. Nanotechnology has the potential to transform orthopaedic surgery diagnosis and treatment, however the long-term health implications of nanomaterials are little understood, and further study on clinical safety is needed. Surface science, molecular biology, microelectronics, and tissue engineering are just a few of the scientific fields involved in nanotechnology. Surface science, molecular biology, microelectronics, and tissue engineering are just a few of the scientific fields involved in nanotechnology. This allows for a larger degree of interaction between an implant and native bone in the case of orthopaedic implants, resulting in more efficient osseointegration. [1].

The fact that nanotechnology may allow for more precise therapeutic applications at the subcellular level [2] accounts for a large part of nanotechnology's potential utility in medicine. Nanoengineered materials have the theoretical ability to target and influence cellular processes because many molecules involved in these processes reside and interact fundamentally at the nanometer scale [3].

When it comes to orthopaedics, bone is naturally a nanostructure composition of collagen and hydroxyapatite when broken down to the nanoscale. The practical application of these ideas, as well as an understanding of these linkages, has resulted in advances in the functionality and performance of a wide range of goods, both inside and outside the medical profession [4].

Nanomaterials have been proposed as the next generation of better orthopaedic implant materials, with the goal of improving surface qualities to promote osteoblast function and bone ingrowth. Surfaces of orthopaedic implants are either nanoscale smooth or have component micron particle sizes. These do not provide a biologically inspiring topography as bone has numerous nanometer features because of nanostructured entities.

Nanostructured biomaterials could be used to create one-of-a-kind bone substitute transplants. The nanocomposition of these materials mimics the hierarchic architecture of real bone, allowing for the formation of an apatite (calcium phosphate) layer and the cellular and tissue response to bone remodelling. There is high demand for bone graft because of the increase in orthopaedic surgery resulting from advances in surgical practice and an aging population. As a result, synthetic bone-graft substitutes or biomaterials are a hot topic of study. The largest short-term impact of nanotechnology is most likely patient care, particularly cancer treatment. A bone graft or biomaterial should not only replace the missing bone, but also be intrinsically osteoinductive by acting as a scaffold for guided bone formation.

Nanotechnology for cancer diagnosis and treatment has yielded promising results, with clinical trials moving quickly from the lab to the clinic. The delivery of therapeutic medicines to specific bodily components without hurting healthy tissue is a constant challenge in medicine. Chemotherapeutic chemicals would be delivered to tumour areas specifically, avoiding chemotherapy's nonspecific effects on vulnerable and vital cells like bone marrow cells. The use of nanotechnology in wound dressings may help patients recover more quickly after surgery. Some pharmaceutical businesses use nanoscale components in their formulations or dispersions. Electrospinning produces a nanofibrous polyurethane membrane with properties that make it suitable for wound treatment. The wound dressings offer good oxygen permeability and regulated evaporative water loss. The dressings also encourage fluid drainage, reducing the amount of build-up beneath the covering and preventing wound desiccation [5].

Nanotechnology is a relatively newcomer to orthopaedic research, diagnostics, and treatment. Nanotechnology, on the other hand, has been able to change the science and practise of orthopaedic care in the short period it has been studied and utilised. Many conventional therapies are being replaced, as nanotechnology provides ways to treat the human body in ways that are more precise, better for bone growth, and theoretically safer, at least in terms of infection rates and necessity of re-operations. Nanotechnology, while promising in its infancy, is not a cure for many of orthopaedic surgery's difficulties. Questions about its long-term clinical safety must be answered before its acceptance and acclaim may be expanded. The hazards of lung cytotoxicity and internal organ inflammation that have been suggested through early study need to be investigated further, and if needed, remedy. Nanotechnology's long-term impacts, both positive and negative, must be better studied in order to better grasp its future significance [6].

References:

1. *Karazisis D., Ballo A.M., Petronis S., et al.: The role of well-defined nanotopography of titanium implants on osseointegration: cellular and molecular events in vivo. Int J Nanomedicine 2016;11:1367-82*.
2. *Mattei T.A., Rehman A.A..: 'Extremely minimally invasive': recent advances in nanotechnology research and future applications in neurosurgery. Neurosurg Rev 2015;38:27-37*.
3. *Wong K.K., Liu X.L.: Nanomedicine: a primer for surgeons. Pediatr Surg Int. 2012;28:943-951.*
4. *Smith W.R., Hudson P.W., Ponce B.A. et al.: Nanotechnology in orthopedics: a clinically oriented review. BMC Musculoskelet Disord. 2018;19:67*.
5. *Tasker L.H., Sparey-Taylor G.J., Nokes L.D.: Applications of nanotechnology in orthopaedics. Clinical Orthopaedics and Related Research (1976-2007). 2007;456:243-9*.
6. *Garimella R.,Eltorai A.E.: Nanotechnology in orthopedics. J Ortho. 2016;14:30-33*.