Nanotechnology: Future of Sports Medicine

2 authors:

Yatendra Kumar Sharma
University of Delhi

Sushil Kumar Sharma
Sam Higginbottom University of Agriculture, Technology and Sciences

ISBN : 93-82260-68-4

Circuit Training Group is 1.825 which is significantly higher than that of Non-Circuit Training Group where adjusted mean Scores of Muscular Strength of Non-Circuit Training Group is 1.752 . Thus, the overall performance scores of both the groups Circuit Training Group and Non-Circuit Training group of Muscular Strength were not equal.

There was significant difference between mean score of Shot Put of Circuit Training Group and Non- Circuit Training group by taking Pre-Shot Put as Covariate ($F_{y.x}=17.90$, $df=1/37$, $p<0.01$). Therefore the adjusted mean scores of Shot Put of Circuit Training Group is 6.535 which is significantly higher than that of Non-Circuit Training Group where adjusted mean Scores of Shot Put of Non-Circuit Training Group is 6.098. Thus, the overall performance scores of both the groups Circuit Training Group and Non- Circuit Training group of Shot Put were not equal.

These results help to interpret that the effect of Circuit Training Programme were useful in developing Muscular Strength and Shot Put performance. However, the Circuit Training Programme has been recorded as more effective in improving Physical Fitness component Muscular Strength and Shot Put performance of the Schools Boys aged 13 to 15 years.

Conclusion

Effect of Six weeks Circuit Training Programme intervention has potential benefits to improve Muscular Strength and Shot Put Performance of the Schools Boys aged 13 to 15 years.

Acknowledgement

The investigators are grateful to the students who willingly participated in this study. They are also thankful to the authorities of school who gave permission to conduct this experiment.

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ISBN : 93-82260-68-4

NANOTECHNOLOGY: FUTURE OF SPORTS MEDICINE

Yatendra Sharma, M.P.Ed Student,
Amity School of Physical Education & Sports Sciences, Amity Campus, Noida, (U.P.)
Email: yatendrasharma99@gmail.com
Dr. Sushil Kumar Sharma, Editor,
E-Cronicon Chemistry, UK
Email: drsharmasushil@gmail.com

Abstract

The Nano-bio fusion is a booming area with high expectations that major steps in health treatment, body repair and body improvement can be made. It is regarded as the most innovative domain of this moment. Developments are in the field of:

- Nanomedicine: targeted drug delivery by medically functionalized nanoparticles, for rapid cure without side effects or human stimulation.
- Regenerative medicine: DNA programmed tissue engineering for quick and efficient wound healing, rebuilt of organs and other body parts.
- Smart implants: biocompatible implants that can sense and actuate in order to repair or enhance a body function.

Nanotechnology idea has as of late gone into the exercises of day by day living. Nanotechnology in games solution can be characterized as the adjustment of a wide range of improvements in nanoscale into therapeutic applications related with games wounds. The adjusted advancements can be either specifically related with the restorative mediations, for example, recovery of a tissue, implantation, and drug treatments or supporting components like imaging, strappings, and tapings. In this section, the impression of recently developed nanoscale advancements in regards to games wounds will be talked about with recent researches.

Introduction

Nanotechnology is a scale technology and briefly covers the size scope of 1-100 nm as indicated by the all-inclusive definations made by the national and global activities. In subtle elements, this innovation is connected with comprehension, measuring, imaing, demonstrating and controlling of the materials qualities at nanoscale or controlling the instruments of the frameworks at the scale. Nanotechnology is an interdisciplinary field which covers the common and engineering sciences (i.e., material science, science, science and arithmetic) and wellbeing sciences (Pharmaceuticals/Healthcare) because of its multi-application nature.

These days' people talk about the nanotechnology as a current technology-not a future technology-because it as of now has gone into all parts of our life and different areas including materials creation, instruction, correspondence, software engineering, vitality, sports, developments, mechenics, material and particularly wellbeing/pharmaceuticals science applications (Denkbas and Vaseashta 2008). Wellbeing (Healthcare/Pharmaceutical) science or restorative applications are the absolute most essential gatherings of those application fields because of the immediate consequences for human life. The advancement related with the nanotechnology is so encouraging to conquer the wellbeing issues utilizing this innovation, and this recently developed definition is called as nanomedicine quickly (sahoo et al. 2007).

Nanomedicine contains differing biomedical utilizations of nanotechnology, for example, tumor diagnosis/treatment, tissue building, embedding gadgets, gene/drug delivery, cardiovascular system disseases, surgery, endocrinoloical issues, infectious diseases, therapeutic observing/looks into/records, and in addition sports medicine. Then again nearly in each one of those applications nanotechnological methodologies are so comparative in various cases. For example, hard tissue replacement (bone grafting) or prosthetic devices are same as in accidental injury and sportive fractures. Thusly, advancements in nanomedicine can be moved into sports medicine effortlessly and quickly. Right now we can cateorize the nanotechnological approaches in sports medicine as dianosis/imaging and treatment. Really nanotechnology is be connected to sports medicine, as well as can be utilized as a part of sportive equipments, sportswear, and architecture because of the one of a kind characterstics (i.e., high surface to volume apportion, magnificent characterstics of the materials at nanoscale, for example, silver and gold nanoparticles that they are antibacterial, electrical and warm conductivity are high at nanoscale, and so forth.) of the nanoscale materials and systems.

The Stem cells are viewed as a critical potential source for repairing harmed/damaged human tissues. Recent advancement in pharmaceutical that the bond, development, and separation of undifferentiated organisms are likely controlled by their encompassing microenvironment, which contains both concoction and physical prompts. These signals incorporate the "nanotopography" of the complex extracellular grid or building design that structures a system for human tissues.

Nanotechnological Approaches in Sports Medicinal Therapy

It is excessively troublesome, making it impossible to put a few cutoff points over the therapeutical aspects in sports medicine; however some of them can be compressed particularly with the much of the time utilized applications. For Instance, strapping and taping (nanotextile and adhesive), cryotherapy (nanocryoenicity), electrotherapy, TENS/cathodes, magnetis field/PEMF-SMF, dru/controlled release, regenerative pharmaceutical, and insert applications are some of them.

Cell adhesion in bone grafts associated to nanotechnology

Tissue engineering aims at the advancement of natural substitutes that can restore, keep up, or enhance the usefulness of harmed tissue or organs. To this end, sub-atomic and cell connections might impact the tissue responses to biomaterials. With a specific end goal to be compelling and coordinated to the getting zone, the bone union is required to permit a solid cell grip, connecting with a few particles to impel relocation, separation, and accordingly the mineralization of the new bone on the union. These cell attachment atoms (CAM) will intercede the contact between two cells or in the middle of cells and the extracellular network, a crucial procedure to the accomplishment of the insert.

Nano-particle of Duloxitine hydrochloride as antidepressant

Depression is estimated to affect nearly 340 million people worldwide and 18 million people in the US at any given time making it the third most costly and disabling illness in the US.

Duloxetine hydrochloride is one of the main antidepressant used as a selective serotonin and nor epinephrine reuptake inhibitor (SSNRI) for oral administration. As it works on central nervous system (CNS), drug should be more available to the cells. To increase the efficacy and solubility drug can be formulated with polymers using nano particle as a drug carriers. In this work we propose and analyzed different approaches to study measuring the size of nano particle and effect of these nano particles on the *in vitro* kinetics dissolution behavior. The drug obeyed the beers law over the range of 5-50 µg/ml at λmax 230 nm. Drug with PEG 4000 in 6.8 phosphate buffer is proposed good discriminative dissolution media for Duloxitine hydrochloride delayed release formulation. The quantization of drug release studied by UV-Spectrophotometer at 230 nm. Nano particle size and morphology are determined by Scanning Electron Microscopy (SEM) and Transmission Electron Microscopy (TEM). By fitting the dissolution data in various kinetic models find out delayed release formulation of Duloxitine hydrochloride obey the Higuchi model kinetics having linearity range 0.99 and release component 'n' obtain by the Korsmyer Pappas model indicate release mechanism followed by the anomalous diffusion process.

The comparative *in-vitro* bioavailability study Duloxitine Hydrochloride and Nano-particle of Duloxitine hydrochloride through the comparative dissolution study and also campier the release behavior of drug. Furthermore, this work is the first to show that the dissolution profiles follow Korsmeyer-Peppas model. Nan particulate drug delivery systems seem to be a viable and promising strategy for the biopharmaceutical industry. They have advantages over conventional drug delivery systems. They can increase the bioavailability, solubility and permeability of many potent drugs which are otherwise difficult to deliver orally by the nanoparticles.

Zn-substituted Monetite Based Biomaterial for Bone Regeneration

A bone regeneration biomaterial must be biocompatible, osteoconductive and osteoinductive, and be gradually replaced by newly formed bone in the shorter time possible. Nanostructured materials, emulating bone composition and morphology, have shown great potential in bone repair because of their higher reactivity, faster reabsorption and improved biological behavior over microstructured materials.

Padilla et al. (2015) developed a new biomaterial that meets the requirements for effective bone regeneration. Combination of components with different solubility such as monetite, hydroxyapatite, amorphous calcium phosphate and silica gel, provided with the means to modulate the rate of material resorption of this novel biomaterial were Zn was found to be present as a partial substitution of Ca in the monetite lattice. The biomaterial was obtained by a hydraulic cementing reaction and was characterized by XRD, FTIR, NMR, chemical analysis, N2 adsorption porosimetry, Hg porosimetry, picnometry, SEM, TEM and evaluated *in vitro* and *in vivo*.

Granular biomaterial showed a nanometric structure with a very high specific surface area (≈80 m2/g), high surface roughness and high intragranular porosity (50%) ranging from macro to nanopores. All of these are key features for a bone regeneration material. Solubility studies demonstrate the different solubility of its components and the release of Ca, P, Si and Zn. *In vivo* evaluation showed the effectiveness of the material to regenerate and to maintain 89 ± 9% of the volume of a critical size bone defect in sheep at 16 weeks. Residual biomaterial was found to occupy 10 ± 5% of the defect while newly formed trabeculae occupied 35 ± 6% of the space. The newly formed bone showed abundant vascularization and osteogenic activity. Biomaterial was

ISBN : 93-82260-68-4

estimated to have resorbed by 85 ± 7% with a reduction of 67 ± 8% in area and clear signs of cell-mediated resorption.

i. In vitro proliferation and cytotoxicity

No significantly differences in proliferation of HOb cells in the presence of biomaterial extract were observed when compared to control cultures (Figure 1a). HOb cells showed an elongated morphology with no apparent difference between controls and cells exposed to biomaterial extracts (Figure 1b-1c). Cytotoxicity of the biomaterial extract at 80 vol% in HOb cells was 5±4% against 96±3% observed for the positive control (Triton X-100). Biomaterial was therefore determined to be non-cytotoxic.

ii. In vivo evaluation

Empty osseous defects used as control showed partial regeneration, with only 53±14% of the defect regenerated, after 16 weeks of implantation (Figure 2a) as expected for critically-sized defects. Histological evaluation of control defects showed a homogenous tissue response with partial regeneration and adipose tissue developed throughout the non-regenerated space. Neither hematopoietic bone marrow nor connective tissues were found in any of the control defects in which the limited new bone formed inwards from the border of the defects. In two out of the five cases, cortical bone was formed at the superficial part of the defect with the remaining non-regenerated area forming a cavity under the cortical.

A unique nanotechnology strategy used to entrap, protect, and stabilize therapeutic agents into polymer coatings acting as nanoreservoirs enrobing nanofibers of implantable membranes. Upon contact with cells, therapeutic agents become available through enzymatic degradation of the nanoreservoirs. As cells grow, divide, and infiltrate deeper into the porous membrane, they trigger slow and progressive release of therapeutic agents that, in turn, stimulate further cell proliferation. This constitutes the first instance of a smart living nanostructured hybrid membrane for regenerative medicine. The cell contact-dependent bioerodable nanoreservoirs described here will permit sustained release of drugs, genes, growth factors, etc., opening a general route to the design of sophisticated cell-therapy implants capable of robust and durable regeneration of a broad variety of tissues.

ISBN : 93-82260-68-4

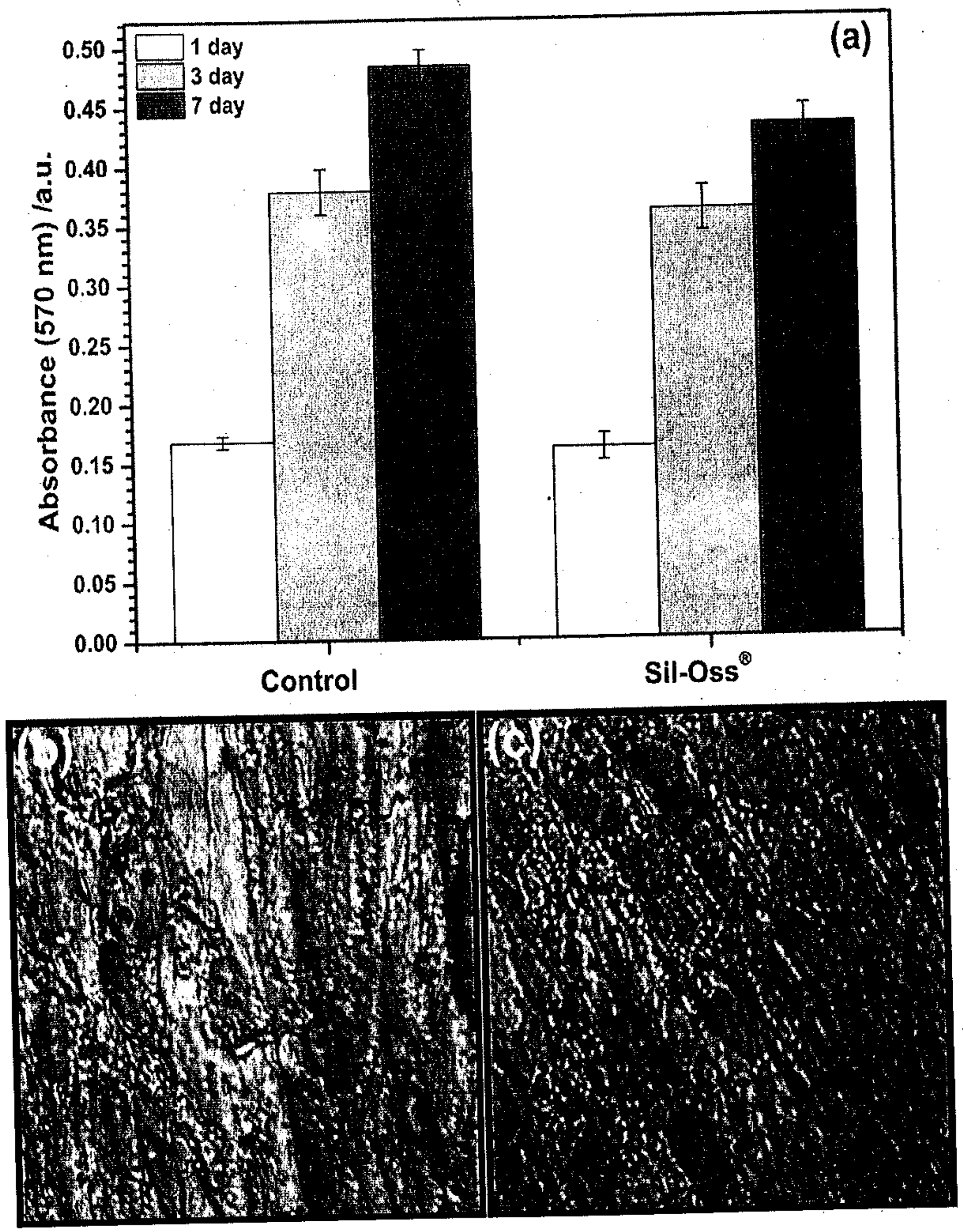

Figure 1: (a) *In vitro* proliferation of HObs cells in the presence of biomaterial extract and control medium. Micrographs of cells with (b) control medium and with (c) biomaterial extract at 7 days. Cell proliferation and cell morphology were unaffected by the biomaterial extract. Results are mean ± confidence interval; n=3; α=0.05.

ISBN : 93-82260-68-4

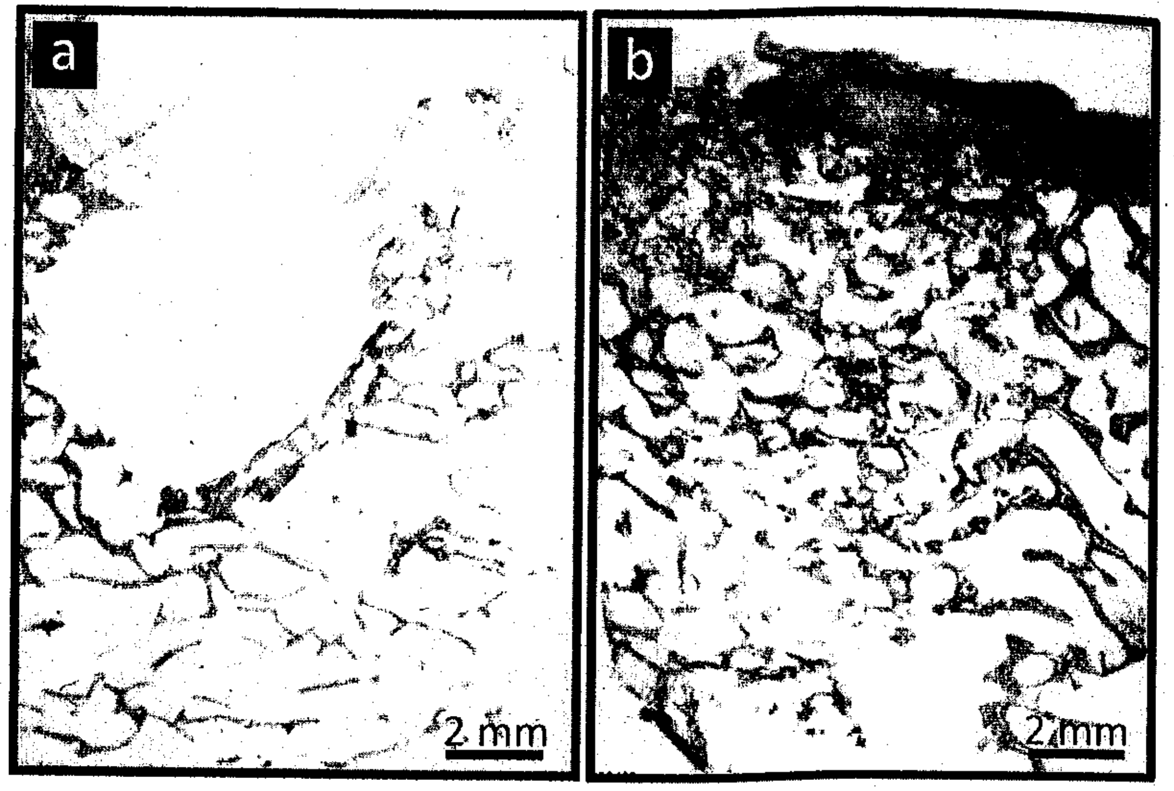

Figure 2: Representative low magnification histological images of critical size defects in sheep after 16 weeks (a) with no implanted material and (b) treated with biomaterial, showing significantly greater bone regeneration of the treated defect when compared to untreated control. Goldner's trichrome stain shows mineralized bone in blue, collagen fibers present in non-mineralized tissue in red, corresponding to connective tissue outside defect and to non-mineralized organic bone matrix (osteoid) inside defect.

Cryotherapy

Cryotherapy is the most as often as possible utilized method as a part of the instances of sports injuries particularly intense musculoskeletal ones for the minimization of inflammation and maximization of the functional recovery (Lubkowska 2012; Myrer et al. 2001). For this purpose for the most part, cryokinetic methodology is utilized by alternating ice and exercise during the rehabilitation in this therapy/treatment. The ice packs can be utilized during the intense/acute cryotherapies, and nanoparticular added substances appear to be encouraging to get compelling and maintain ice nucleation and more proficiency with ice packs (Zhang et al. 2011). Another marker for the productivity of nanoparticles in cryotherapy with ice packs is about cryonanosurgery which comprises of local cryogenicity during the surgical operation and utilization of the polymeric nanoparticles into the tumor area to get sharp fringes/borders of the tumors for resection (Liu and Deng 2009).

Nanotechnology in Diagnosis/Medical Imaging

Medical imaging advancements have crucial role in right on time detection, surgical operations, and postoperative control periods. X-ray, magnetic resonance imaging (MRI), automated tomography, and ultrasound are the main representation techniques to recognize soft or hard

ISBN : 93-82260-68-4

tissue wounds. Especially magnetic resonance imaging (MRI) has promising applications in sports injuries, for example, diagnosis and treatment of musculoskeletal trauma. This imaging technique offers inherent soft tissue contrast allowing direct visualization of cartilage, muscle, tendons, and other soft tissues, multiplanar imaging capability and extreme imaging flexibility, high patient acceptance, and non-invasive imaging method without ionizing radiation (Featherstone 1994; Shokrollahi et al. 2014). Nanoparticles are commonly used as contrast agents in magnetic resonance imaging processes in order to detect targeted organs or tissues (Fig. 3).

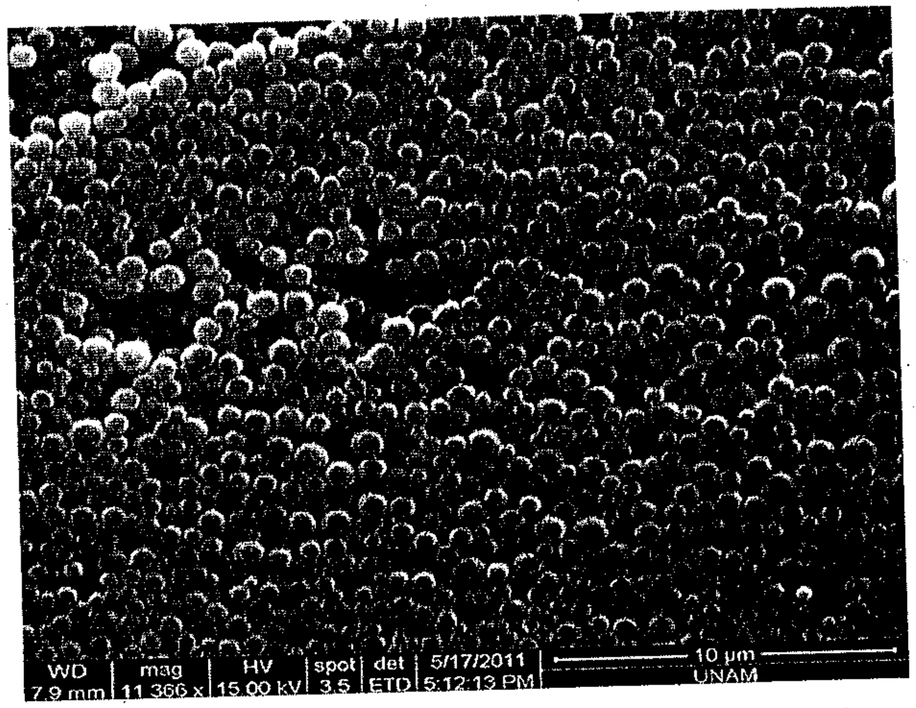

Figure 3: Representative image of bio polymeric nanoparticles to be used in MRI contrast agents

Nanotechnology in Regenerative Medicine

Today's brilliant biomaterials and treatments expect to repair and recover the tissue of interest as opposed to a basic substitution (Rosso et al. 2005; Furth et al. 2007; Shastri and Lendlein 2009). The approach is considerably more deliberate in sports injuries, following the cases are not age, sex, or another parameter subordinate. For instance, osteoarthritis and osteoporosis might require an extra sort of medicines, for example, drug therapy (Ricciardi et al. 2013), though in sports injuries the principle center is to recuperate applicable tissue without considering whatever is left of the body. As the giant leaps had been succeeded in past decades in the biomaterials science, because of the astounding advantages of newly emerged nanotechnology, it has gotten to be simpler to comprehend the tissue association and mending at cell and even subcellular scale (Whitesides and Wong 2006; Fisher et al. 2010; Liu et al. 2012). Biomaterials with submicron and Nano scale features are as a rule broadly utilized for tissue recovery contemplates for musculoskeletal framework, and the potential uses of Nano scaled materials are developing in orthopedic medicines (Variola et al. 2011).

Nanotechnology in Topical Drug Delivery

Soft tissues in the body such as muscles, tendons, and ligaments are injured frequently during sports, and most of the soft tissue injuries are painful because of the inflammation and swelling at the defect site. Anti-inflammatory and nonsteroidal anti-inflammatory drugs (NSAIDs) are commonly used in the treatment of sprains and strains and have a potential for topical delivery. Transdermal drug delivery has substantial advantages compared to other types of conventional routes. Transdermal route offers an advantage of passing hepatic metabolism which reduces the drug efficiency, and loading of relevant drug into biodegradable nanoparticles brings additional advantages. Nanoparticles have the potential to effectively transport drugs through the skin and enhance drug absorption allowing sustained drug release for a prolonged period of time and also protecting the encapsulated substance from chemical degradation.

Conclusion

The examples of nanotechnology-assisted solutions for sports medicine diagnosis and treatment increase day by day. The progress in textile industry, imaging's, tissue engineering, and drug delivery with the help of nanotechnology-based approaches exhibits new products and methods for the medical area. Nano scale-based technology has entered almost every material-related area. Materials related with medicine provide an extra added value among all areas, since they help patients to regain their health and improve life quality. All these references in this chapter are the reflections of the aforementioned developments, and new ones will be added on certainly

Carbon nanomaterials and **Zn-substituted Monetite** have extensively studied over the last two decades for target drug delivery, use as drug carriers, tissue scaffolds, as anti-bacterialagents, MRI contrast agents, and new biosensors, and in regenerative medicine, photothermaltherapy, and electrochemotherapy. Significant advances have been made in technology, engineering, and animal study. The field continues to hold huge potential for the development of more effective therapies for cardiovascular disease, cancer, neuro-disease, musculoskeletal disorder, and diabetes mellitus. This paper reviewed the current status of carbon nanomaterial applications in medicine as new biomaterials for drug delivery and regenerative engineering. The major challenge facing the research community currently is the possibility of longterm toxicity of carbon nanomaterials compared to biodegradable type organic polymers. Whether and how those carbon nanomaterials affect long-term immune-response to downstream events of foreign body reaction have not yet been systemically demonstrated. More *in vivo* studies and pre-clinical tests are definitely needed before these materials can be translated into the market place.

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