

IIT Roorkee synthesizes orthopedic implants for healing bone fractures

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IIT Roorkee researchers have synthesized bioresorbable and economical orthopedic implants for healing bone fractures.

The current therapeutic strategies for healing bone defects commonly suffer from the occurrence of bacterial contamination on the graft, resulting in non-union in the segmental bone defects and the requirement for secondary surgery to remove or sterilize the primary graft.

A membrane with enhanced anti-bacterial efficacy, mechanical strength and osteoconductivity would represent an improvement in the therapeutic strategy for guided bone regeneration. The two independent studies have been published in the International Journal of Biological Macromolecules and RSC Advances.

The study aimed to optimize the content of halloysite nanotubes (HNTs) and TiO₂ in the polymer matrix of chitosan (CTS) with a constant amount of nano-hydroxyapatite (5%) with the objective of mimicking the mechanical and biological microenvironment of the natural bone extracellular matrix with enhanced anti-bacterial efficacy.

“The current clinical grafting methods suffer from post-operative infections and the unwarranted adhesion between the healing bone and the adjacent soft tissues. A membrane with enhanced anti-bacterial efficacy would fight-off any post-operative bacterial infections on their own without any secondary interventions or surgeries, thus helping reduce the cost and the healing time. A mechanically strong membrane would provide a barrier for maintaining the original shape of the bone and avert any postoperative attachment between the bone and the surrounding soft tissues. These two associated complications with the current standards inspired these studies” said Sarim Khan, who is the first author on the two studies.

The study establishes that the addition of an optimized amount of natural clay mineral (Halloysite) to a chitosan matrix results in a bioresorbable membrane which is ideal for bone tissue regeneration in humans. In the study, they have shown that the membrane is highly favorable to osteoblasts (bone cells) for bone regeneration.

The membrane possesses enhanced antibacterial resistance so it can fight off any postoperative infections. Lastly, the membranes possess a superior tensile strength of 67 MPa and enhanced elastic behavior, which will help the membrane in undergoing day to day mechanical fatigue cycles without any damage. These membranes can be implanted instead of the traditional metallic stents and plates because they are way cheaper (300 times) and there is no need for secondary surgery to

remove the stents and plates as these grafts are bioresorbable.

Moreover, this method does away with the other complications associated with the traditional clinical grafting methods such as donor site morbidity, the limited supply of grafting material, and immunogenic rejection. Research has shown that 20% of women aged over 50 in India suffer from osteoporosis, such a low-cost alternative would make the treatment affordable for healing fractures due to osteoporosis in women. The research team is currently planning on working with industries to run clinical trials in order to establish its commercial use.