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Smart Orthopedic Screws For Non-Invasive Imaging Through Tissue (2012-018)

Allows Non-Invasive Monitoring of Implants via X-Ray Excitable Materials Incorporated into the Screws

Market Overview

These smart orthopedic screws allow physicians to noninvasively detect and monitor the health of bone implants, potentially preventing infection and implant loosening over time. In the United States, musculoskeletal injuries affect over 28 million patients annually – at least two million of which require fracture fixation surgery. These surgeries typically involve bone implants that are held in place by orthopedic screws, ensuring their functional position is held in place over time. In the cases of surgical fracture fixation, it's important to monitor the fixation health of the implants since refracture, malunion, infection, and loosening occurs in almost 10% of all orthopedic and dental implants due to mechanical strain. While optical-based options for measuring implant strain are currently available, such as Moire pattern analysis and photoelastic polarimetry, these approaches are insufficient for measuring through tissue due to limitations imposed by the background, spectral distortion, and resolution. Clemson University researchers have developed "smart" orthopedic screws that incorporate x-ray excitable materials so detection through tissue is possible. This approach enables noninvasive monitoring and detection of implant strain so preventative measures can be taken to limit patient stress.

Technical Summary

These tension-indicating screws provide physicians with the ability to "see" bone implants noninvasively. Physicians can gauge the fixation health of implants by sensing the mechanical strain indicated by x-ray excited materials in the orthopedic screws. By incorporating biocompatible luminescent materials – such as fluorescent, phosphorescent, red and near infrared phosphorescent dyes – detection of the screws through living tissue is achievable. This method allows for many types of indicator dyes to be used in the screws, making the method accessible and simple to implement. The dyes can be detected via near infrared laser or x-ray, allowing physicians to gauge implant strain and potential loosening or infection safely and accurately.

Application

Monitoring orthopedic implants; preventative medicine

Development Stage

Research Ongoing

Advantages

- Exhibits biocompatible luminescence that is detectable through living tissue, allowing physicians to non-invasively locate potential implant loosening and determine the callus is stiff enough to allow weight-bearing with low risk of refracture
- Senses implant strain earlier, improving diagnostics and reducing patient stress
- Utilizes high resolution x-ray excited optical luminescence, providing a more accurate and quantitative measurement of implant strain

App Type	Country	Serial No.	Patent No.	CURF Ref. No.	Inventors
Non-Provisional	United States	61/680,419 13/960,881	9,179,865	2012-018	Dr. Jeffrey Anker Jonothan Heath, Dakota Anderson, Melissa Rogalski

About the Inventor

Dr. Jeffrey Anker

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Dr. Jeffrey Anker earned his B.S from Yale University and his Ph.D. from the University of Michigan where he worked on magnetically modulated fluorescence-based sensors. Before joining Clemson University, Dr. Anker was an NIH Postdoctoral Fellow at Northwestern University. He is currently a member of the Center for Optical Materials Science and Engineering Technologies (COMSET). Dr. Anker has an issued patent and several other applications in prosecution. His research interests focus on optical spectroscopy and nanoparticle devices to study chemical and bioanalytical processes.

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