Tri-resolution Visualization System for Stem Cells and Tissue Regeneration Monitoring

Grant Award Details

Tri-resolution Visualization System for Stem Cells and Tissue Regeneration Monitoring

Grant Type: Tools and Technologies II

Grant Number: RT2-02057

Project Objective: Objective is to create an imaging modality that can image stem cells in preclinical models using combined SPECT, MRI and microscope in the same imaging tool

Investigator:

Name:	Joann Zhang
Institution:	TriFoil Imaging, Inc.
Type:	PI

Human Stem Cell Use: Adult Stem Cell

Award Value: $1,456,989

Status: Closed

Progress Reports

Reporting Period: Year 1

View Report

Reporting Period: Year 2

View Report

Reporting Period: Year 3

View Report

Reporting Period: NCE

View Report

Grant Application Details

Application Title: Tri-resolution Visualization System for Stem Cells and Tissue Regeneration Monitoring

Public Abstract: The 3D imaging techniques of CT and MRI have virtually eliminated the need for exploratory surgery – a procedure which was common in difficult cases just 20-30 years ago. Not only is imaging used to discover the extent of disease, it is now used to measure the effect of therapies. The "size" of a tumor is stabilized under effective treatment – and this arrested growth can be measured with CT or MRI. New "molecular imaging" techniques (eg, SPECT) can create images of the biological processes associated with the cancer – the aggressive metabolism of cancer cells and the invasive signatures of uncontrolled growth. Images of the cessation of these processes provide a much earlier (hours-days rather than weeks-months) assessment for physicians to decide quickly upon alternative treatments if the therapy is not working.

We propose to create an imaging tool for stem cell therapies that combines the strengths of two powerful imaging modalities currently in use in both pre-clinical research and clinical practice: MRI and SPECT. Our goal is to translate this tool to the clinic to provide answers to three fundamental questions of any stem cell therapy: 1) where are the stem cells located? 2) what is the status of the stem cells? and 3) is the curative biological effect taking place? The SPECT/MRI imaging tool will be used for pre-clinical research with laboratory mice and rats. It will use MRI to provide the anatomical context – the 3D environment of the cells – by using its exquisite ability to visualize soft tissue anatomy. In the proposed pre-clinical prototype, we will use the SPECT imaging to "zoom in" on the stem cells themselves through the use of ultra-high resolution techniques that we are developing in an ongoing CIRM project. This "zoom" SPECT will be combined with the ability to simultaneously image biological processes with a second SPECT contrast agent. This use of multiple contrast agents is a unique functionality of SPECT. Our preliminary research results show SPECT imaging of both stem cells and regeneration processes in an Achilles tendon (AT) injury experiment in laboratory mice. Our unique SPECT imaging hardware is compatible with high magnetic fields of MRI. Upon the successful demonstration of the ability of MRI visualize the anatomy and SPECT to locate stem cells and to visualize the tissue regeneration in the AT model, we can begin to design the SPECT/MRI instrument for monitoring future stem cell therapies in human patients. The translation from the research lab to the human clinic is the primary component of this "tools and technologies" project. Our SPECT/MRI imager will provide non-invasive feedback to physicians employing any stem cell therapies as curative regeneration is taking place. Ultimately, a SPECT/MRI image from a scanner whose origins can be traced to this project will be the verification of a complete cure in diseases and conditions that are not being effectively treated today.

Statement of Benefit to California:

CIRM's "Tools and Technologies" program highlights the main pathway to rapid, large-scale implementation of new ideas: the small company. [REDACTED] operate on the cutting edge – they take bold risks and create jobs, patent inventions and, as "start ups" – disrupt the status quo inertia of the larger companies. In the field of advanced medical imaging, California's small companies and academic researchers have played the starring role in the adoption of pre-clinical imaging and the emerging field of "Molecular Breast Imaging". In PET, which has experienced the largest growth of all imaging modalities in the past decade, practical instruments for mass production were pioneered in the 1970s and 80s. The field of microPET has also grown to have hundreds of installations in medical research labs. [REDACTED] introduced microPET designs for the small company Concorde in Tennessee, which eventually became part of the conglomerate Siemens. [REDACTED] developed a competing microPET technology in Canada which is now part of the California company [REDACTED] product portfolio.

It was [REDACTED], however, that transformed the field of small animal imaging with the introduction of "multi-modality": SPECT/CT (2002), PET/CT (2005), and tri-modality SPECT/PET/CT (2007). These high-risk decisions in an emerging marketplace have created a standard for research on intact animal models, dramatically lowering the numbers of animals needed while improving the quality of the research. [REDACTED] is also the leader in "Molecular Breast Imaging (MBI)", which can detect early, treatable tumors where mammography is ineffective (ie, in dense breasts). MBI can also non-invasively probe cancer biology and its response to therapies. Other California small companies, namely [REDACTED], are competing to introduce molecular imaging methods to the clinic. California has the right combination of academic prowess and business know-how to get innovative imaging technologies into the hands of researchers and clinicians. These products not only create jobs at the companies, they expand the job market in research labs and clinics where these instruments are introduced. Just as MRI has become the standard for evaluation of sports injuries, the proposed project will lead to SPECT/MRI becoming the standard for assessing the progress and success of stem cell therapies in the cure of a variety of ailments and conditions. The SPECT technology that is compatible with strong magnetic fields of MRI was first put to use in commercial products by the innovative company [REDACTED]. The SPECT/MRI development is being developed by [REDACTED] in collaboration with researchers at [REDACTED] specializing in musculoskeletal stem cell therapies.
