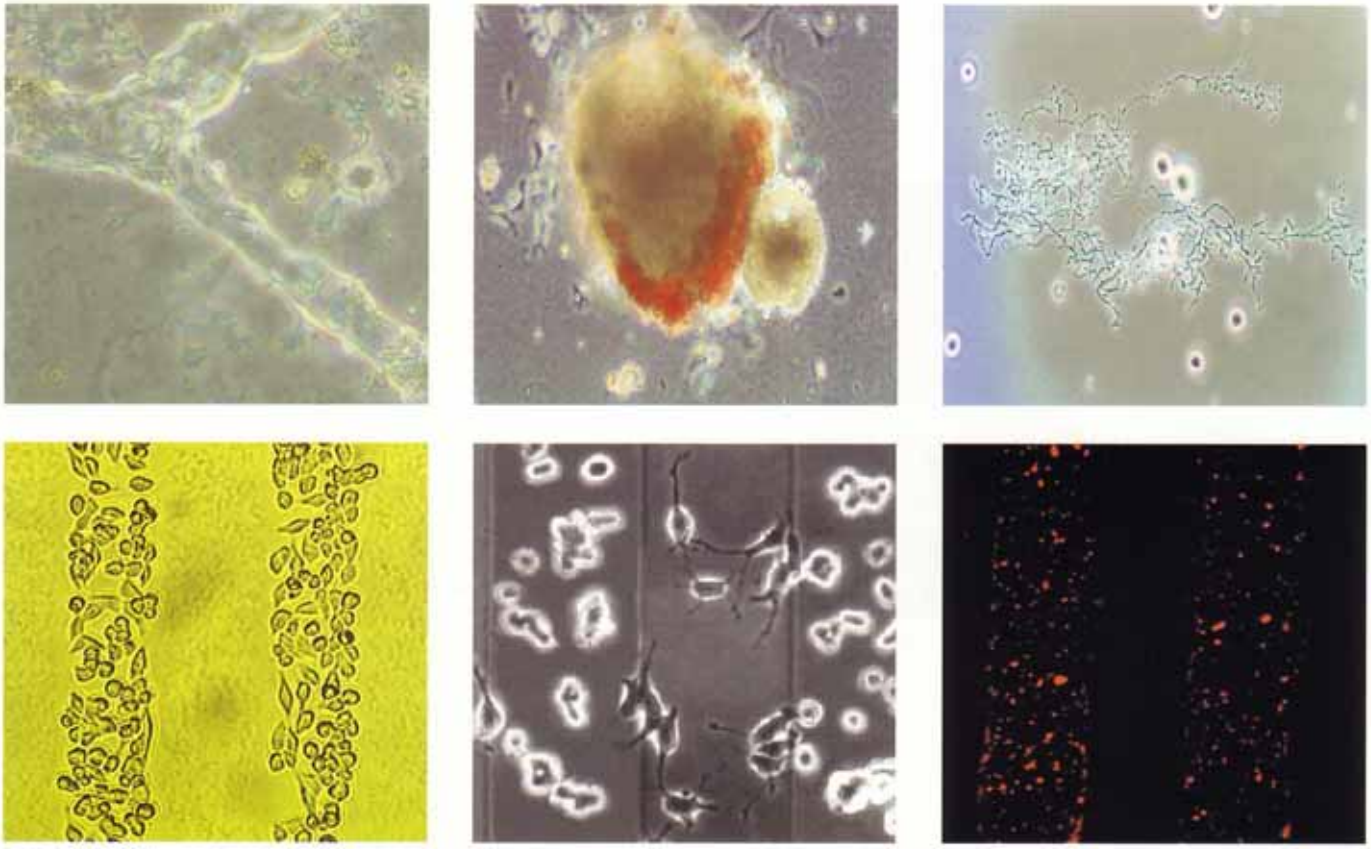
5-Year Project

Creation of novel medical devices by combining biotechnology and nanotechnology

Bioreactor for Regenerative Medicine

Project Leader

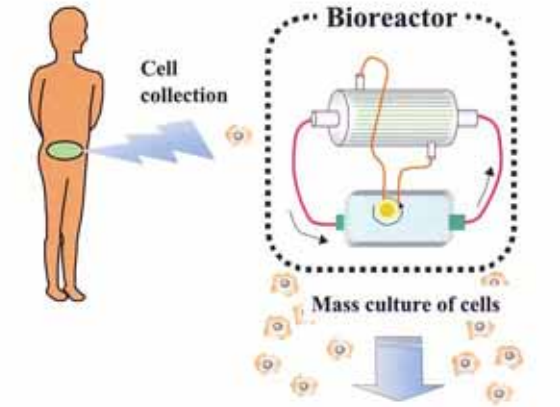
Yoshihiro Ito



Some kinds of cells cultured on substrata

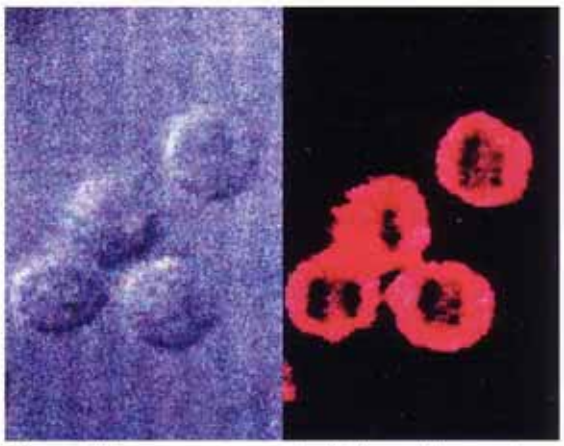
We have made remarkable progress over the past 50 years in restoring the structure and function of damaged and dysfunctional tissue through bionic devices and organ transplants. Such replacement parts, however, still pose significant biological problems and are not appropriate for all situations. Ideally, we could regenerate damaged tissue in vivo. Research in the emerging field of regenerative medicine is bringing that wish closer to reality.

The purpose of the project is to create bioreactors for the safe and rapid expansion of human stem cells, using cytokine-immobilized materials developed by Dr. Yoshihiro Ito. So far, cell culture has been developed, and the technology has resulted in dramatic progress in the life sciences. Today, the technology has become common as an experimental tool by using serum or feeder cells derived from animals. However, in developing human cells for medical therapy, these animal-derived materials should be deleted from the culture medium to avoid virus or prion contamination. The project aims to develop completely artificial cell culture systems without using animal-derived materials.



Immuno-therapy	**Gene therapy**
Transfusion medicine	**Regenerative medicine**
Hematopoietic stem cell transplantation	

The purpose of the project



Phase difference micrograph (left) and laser micrograph (right) of cultured cells

Cell cultures

●Contents of Research

1) Bioreactors using human stromal cells

Hematopoietic stem cell (HSC) transplantation has been developed through bone marrow transplantation and peripheral blood stem cell transplantation into cord blood as medical therapy. However, the number of HSC in cord blood is insufficient for therapy of adult patients. The number of HSC for transplantation must be increased. In the present project, bioreactors will be constructed to efficiently culture HSC using artificial extracellular matrices by co-culture with human stromal cells immortalized by gene transfection.

The culture of HSC will also contribute to gene therapy. In addition, the culture will be used to produce blood cells needed for blood transfusion therapy or for the preparation of blood-derived materials without virus or prion contamination.

2) Bioreactors using cytokine-immobilized materials

Bioreactors composed of materials immobilized with various types of cytokine will be developed. These bioreactors are ideal because they have no animal-derived materials. Previous research has revealed that cytokine-immobilized materials are useful for cell culture systems because of their long-lasting activation onto cells. The project will develop new medical bioreactors for various stem cells by using these materials.

3) Creation of novel medical devices by micro/nano-fabrication techniques

Recently, biotechnology has expanded to include bio/nano-technology with the progress of micro-fabrication technology and nanotechnology. The development of DNA micro-arrays and protein chips is an important result of the fusion of biotechnology and micro-technology. The project will develop novel medical devices using materials that mimic biological cell membranes by nano-level regulation (molecular orientation and distribution) of immobilized molecules.

●Organization of Research

Term: April 2002 to March 2007
Structure: Project leader, 2 regular researchers, a part-time researcher, 2 researchers from a company and a part-time clerk. This project will also accept postdoctoral research fellows from all over the world to promote cooperative research.
Location: Laboratory is located at Kanagawa Science Park (KSP) East 3F