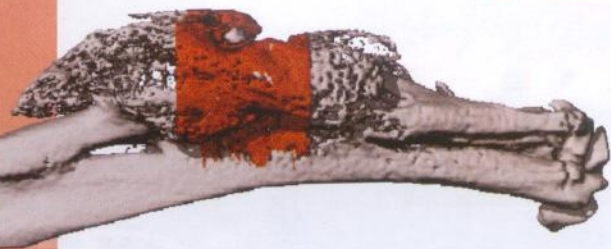


The Wonder of Stem Cells

By Susan Goodman

University scholars are world leaders in stem cell research, creating the foundations for novel treatments while also elucidating basic processes in the development of life



Adult stem cells are used to regenerate skeletal tissues such as bone (above) and inter-vertebral discs (opposite)



IT was the stuff of science fiction back in the 1970s: the stars of the Six Million Dollar Man and Bionic Woman were so badly injured in accidents that they could only be reconstructed using special hi-tech implants that gave them superhuman powers.

While modern surgical methods utilize plastic and metal synthetic implants, they are not as successful or reliable as the body parts they replace. Of course surgeons have also developed techniques for transplanting whole organs from one person to another — however, spare organs are not readily available. Moreover, when an organ is transplanted into another person it is immediately identified as foreign tissue and is rejected unless the recipient receives powerful medication to deactivate their immune system.

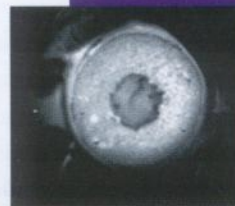
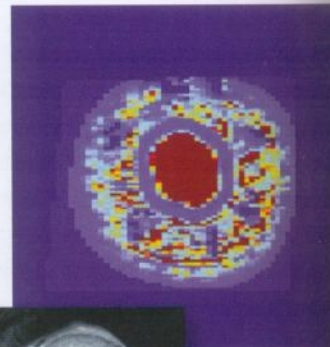
The ideal is for the body itself to be spurred into regenerating tissues and whole organs that have become extensively damaged or non-functioning due to injury or disease: new brain cells to replace those destroyed by Alzheimer's, new muscle for damaged hearts, new nerve tissue for spinal injuries, regenerating bone growth where fractures fail to heal or spinal vertebrae collapse.

The development of stem cell research means that this is now starting to happen, with scientists in the life and biomedical sciences creating the foundations for tomorrow's medical practice. Such research depends

on harvesting "uncommitted", or undifferentiated, cells which have not been allocated any specific function. With appropriate biological instructions, these so-called "stem" cells can be triggered to grow into the exact cells or organs needed. The highly versatile, immature stem cells found in the early stages of embryo development are called embryonic stem cells (ESCs). Stem cells, available in minute quantities, in adult bone marrow and fat tissue are called adult stem cells (MSCs).

FOR certain therapies, MSCs offer particular advantages: "When reinjected into the patient they don't produce an immune response," says Dr. Gadi Pelled, a member of Professor Dan Gazit's team at the Skeletal Biotechnology Laboratory in the Faculty of Dental Medicine. "They also have the advantage that you can easily direct them to become a particular type of cell."

Research at the Skeletal Biotechnology Laboratory is well advanced in developing a process whereby MSCs are used to regenerate skeletal tissues like bone, cartilage, tendon and the inter-





vertebral disc in patients with various injuries. Indeed, the lab's work has made it a world leader in the field of tissue engineering. "In particular, there has been much interest in the 'vertebro bioplasty' novel strategy we have developed for curing complex spinal vertebral fractures among osteoporotic women," says Gazit.

Three stages are involved in reaching the goal of tissue regeneration. The first involves fishing out the MSCs from the soup of cells found in bone marrow, where they make up only 0.01 percent of the total. Dr. Zulma Gazit, a member of the team, has developed a unique method for efficiently isolating the MSCs. At the second stage the MSCs, which are capable of growing into a whole range of tissues, must somehow be directed to produce only the cells that are needed. This is done by introducing a specific gene into the MSC.

Gazit's group has become the world's leading lab in developing a completely new method for sneaking new genetic material into the nucleus of MSCs. Called "nucleofection", it involves applying a small electrical current to the MSCs that opens up, for a very short time, microscopic holes — or "nanopores" — in the cell wall through which the special genes can enter. Once inside the cell, these genes give instructions to turn the MSC into a specific committed cell.

Now that the cells are primed for making different skeletal tissues, the third and final stage of the process involves mixing them with a matrix that will carry the cells, by injection, into the site of injury.

Part of this project is already entering a clinical trial with

Dr. Gadli Pelled (left) and Prof. Dan Gazit (center) with team members (from right) Dr. Yoram Zilberman, Dr. Zulma Gazit and Dr. Yossi Gazit



Prof. David Heyd



Sasson Ziv

Cell Protection

"Producing fertilized eggs when undergoing IVF treatment requires an immense emotional investment from the couple hoping to have a child," says Professor David Heyd of the Department of Philosophy and a member of the Hinxton Group, an international consortium on stem cell ethics. As a member of an advisory board to the Israeli government on issues of medical ethics, Heyd has given careful deliberation to this area of research.

Ethicists insist that these fertilized eggs remain the property of the parents even when there is no possibility of using them and they have been designated supernumerary or "spares". Israeli law, influenced by halacha (Jewish law), does not allow them to be donated to other infertile couples. The law, however, allows them to donate the fertilized eggs for stem cell research.

Strict controls, clarifies Prof. Heyd, dictate the nature of the research that can be carried out — and adhere to the internationally recognized principle of according "respect" to the blastocyst with its potential to develop into a human being.

The law is reviewed every five years, not only in response to developments in scientific activity but also because of shifts in public opinion. Attitudes change remarkably quickly. "It took less than a decade for public acceptance of IVF, organ transplant and surrogacy," says Prof. Heyd. "Nothing succeeds like success; as soon as the benefit to people becomes clear, society's attitude shifts — ethical opposition melts away."