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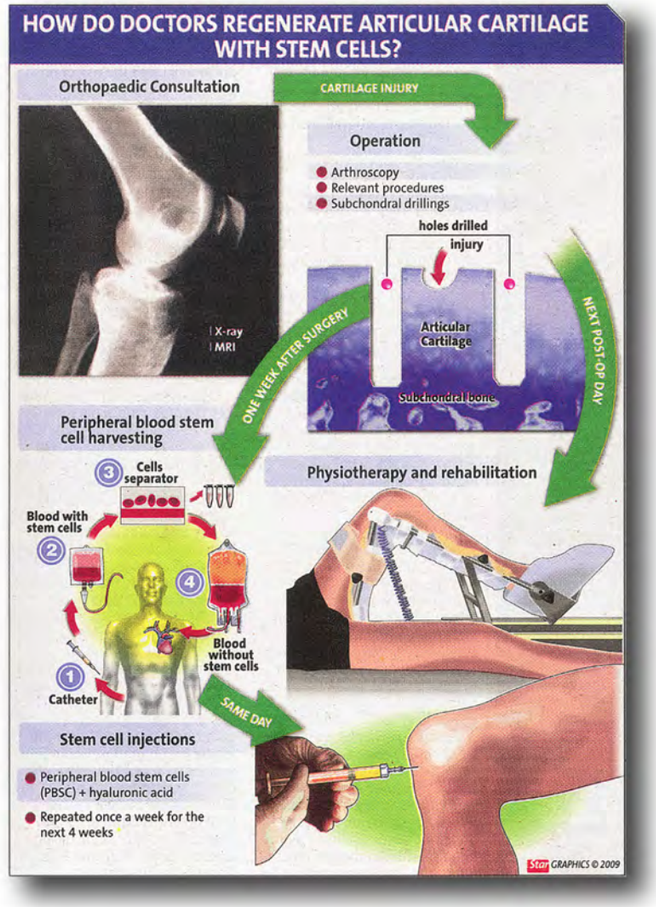
Stem-ming joints

Learn about a procedure that uses the body's own cells to accelerate the natural healing process that occurs in knee cartilage. >SF2



Regenerating cartilage

With a simple, new technique, orthopaedic surgeons can now regenerate damaged cartilage in injured joints with stems cells harvested from their patients' own blood.

By LIM WEY WEN
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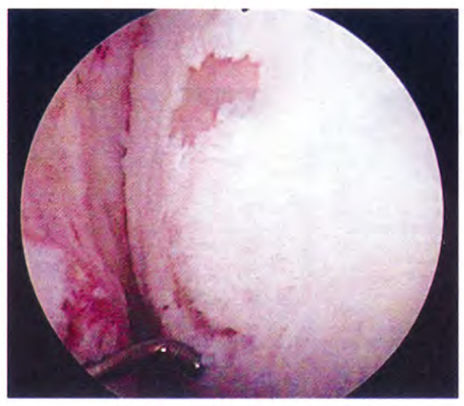
AS she took the last steps to the top of Batu Caves, Joanna Hart was exhilarated. It was not something expected she could ever achieve at this point of her life, not when only two years ago, at age 34, she was offered an option usually given to people twice her age: a knee replacement for her left knee.

"Every time I go for X-rays, the radiologist look at the result and go, "'Gosh, what happened to your knee? Your knee looked like a 70-year-old's!' It was very bad," she described.

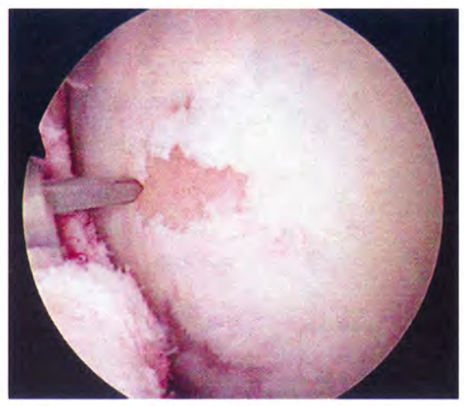
The medical history of her left knee was as extensive as it was active. Recurrent dislocations when she was 16 to 19 years old had resulted in a bad knee. "I was doing the high jump, long jump, relay, netball and hockey then. And so when I was 19 my kneecap dislocated – it wouldn't stay in, it kept coming out," she explained.

Her doctors recommended surgery to set her kneecap in the correct position to avoid it from dislocating further. However, it ended up giving her a different set of problems. The kneecap was set too high and it was rubbing against her bones.

"Over the years, all the cartilage got worn away," she said. And as a result of that, bone spurs (osteophytes) started growing where her cartilage had worn off.



This arthroscopic view of a knee joint shows cartilage damage – the white cartilage has worn away, exposing the underlying bone.



Subchondral drilling involves drilling the underlying bone to initiate cartilage repair.

"As a midwife, I was very active. And I kept fracturing off those osteophytes and they got stuck in my joint," she said. "And by then I wouldn't be able to straighten or bend my leg because it'll be locked. So, I had to go for surgery – they'll pull the bit out, sew it up, and off I go again. This kept happening over a period of about 10 years."

But being physically active in her line of work had kept her knee mobile. It was only when she stopped working that the spurs began building up in her joints again.

"Again, I couldn't straighten my leg. So, I went to see a surgeon, who looked at the results of my arthroscopy (a minimally invasive surgical procedure to examine or treat a joint), and told me that I needed a total knee replacement," she said.

As Hart was not keen on the idea, she hesitated – until she found another option that she could accept.

Stem cell repair

What Hart stumbled upon was a minimally invasive procedure, which was in its final stages of research in goats.

Using stem cells from goats, the doctors were able to stimulate cartilage regeneration in the goats' knees.

"My quality of life was getting lesser by the day because at that point, after all the surgeries, I had to give up athletics, netball and hockey. And then I had to give up jogging and running," Hart said.

However, what mattered most to her were not the activities she had to give up, but the life she was looking forward to with her children.

"I have two young children and I want to be able to go horse riding and skiing with them. A knee replacement is only going to stop the pain, but it would not make the restrictions any better."

So, after the completion of animal studies (now accepted for publication in the *Arthroscopy: The Journal of Arthroscopic and Related Surgery*), Hart proceeded with the surgery. "Now I'm able to jog a little – more like shuffling, really – but I'm moving around a lot more, and I'm going for a skiing holiday this Christmas!" she said with a big grin.

"It's really simple," said orthopaedic surgeon Dr Saw Khay Yong, who led the research. "Once the diagnosis of cartilage injury is made, we then start with surgery where the patient has arthroscopy with subchondral drillings into the damaged cartilage areas.

"The stem cells are then harvested one week after surgery. It is a weekly injection into the knee joint starting at one week after surgery, for five consecutive weeks."

Getting creative with old tools

"Peripheral blood stem cells (PBSCs) have been used by haematologists to treat leukemia patients for the last 20 years and subchondral drilling (the drilling of bone under cartilage layers) is also an established procedure in orthopaedics," he said.

It all came together when Dr Saw and his colleagues, spurred by the desire to find another alternative to conventional methods of treating damaged cartilage, decided to give stem cells a try.

"If you look at cartilage injuries, currently there are a lot of possible solutions, but the results are inconsistent," he said.

As some of the current options to treat damaged cartilage (autologous chondrocyte implantations, cartilage transfers and cartilage transplants) may be quite expensive and they often require multiple surgeries, they have never been attractive to him, Dr Saw said.

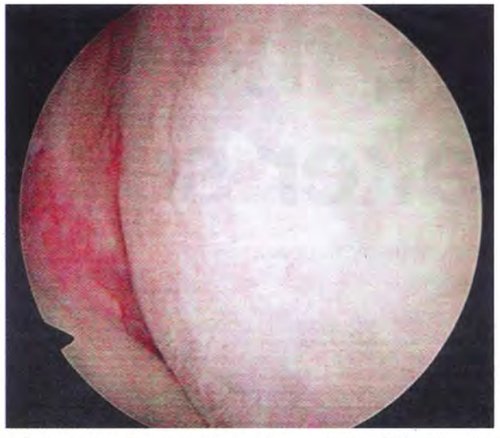
"So, we started to look into ways we can use stem cells to regenerate our cartilage with the University Veterinary Hospital at Universiti Putra Malaysia," he added.

Their study in goats started in 2005, where Dr Saw's team harvested stem cells from goat bone marrow and injected them into the goats' knees after creating defects (by drilling holes in the cartilage and bone in their joints). When the study was completed in 2007, they proceeded to perform the procedure in humans.

What the procedure does is to accelerate the natural healing process that happens in articular (or hyaline) cartilages in the knee.

"Usually, when you have a partial thickness injury (when the cartilage wear has not exposed the underlying bone), there is no evidence of repair. But when you have a full thickness injury that penetrates into the bone, you can access the bone marrow stem cells within it, which will then initiate repair," he explained.

By creating full thickness injuries by drilling holes in the bones where cartilage has worn out, you can create an environment where the cartilage can start to heal. And, to aid the process, doctors provide the building blocks: stem cells and hyaluronic acid (a chemical present in cartilage).



After repair, the white cartilage is once again seen covering the underlying bone fully.

But how do the stem cells know where to go? Dr Saw explains: "When you drill the bone, it forms a blood clot. And when that happens, injured cells send out homing signals that attract stem cells from the bone marrow. After that, physiotherapy will provide the environment for the cells to grow into cartilage cells.

"And in this procedure, we provide the stem cells through injections," he adds.

For the young and active

Although two-year results of the procedure in his patients are encouraging, Dr Saw is not recommending it for everyone.

As it takes a lot of physiotherapy and time – about two years – to achieve best results, he reckons that this might not be the best alternative for the elderly.

Former Miss Malaysia and model Betty Anne Brohier, 43, would attest to the challenges one has to face during recovery. A torn (and later removed) left meniscus (cartilage in the knee joint) when she was in her teens had stopped her from participating in sports but her job as a model has kept her on her feet (and heels) most of the time.

"It used to be quite painful but I thought it was fine. But throughout the years the pain became worse and it affected both knees," she said.

Her left knee was on the verge of "collapsing" when she finally agreed to undergo the procedure. "After the surgery, I stayed in the hospital for one week. Following that, for about six months, I used to go for physiotherapy three to four hours every day," she said.

The road to recovery was long as she needed to learn how to walk and use her leg again. It took her six weeks after surgery to be able to move her leg. Another five months was spent moving around in crutches.

"No pain, no gain, I guess," she pointed out.