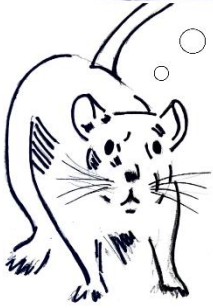


Colour your way through

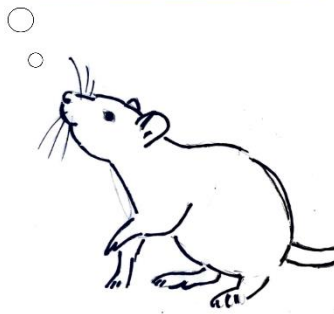
THE HISTORY OF SPINAL CORD RESEARCH

FROM UNTREATABLE CONDITIONS TO THE FIRST PATIENTS TAKING THEIR OWN STEPS AGAIN

Hello! My name is Emile, but my scientist friends call me #42. And I wanna tell you something about the history of spinal cord research



Spinal cord injury (SCI) affects more than 2.5 million people worldwide, with approximately 130 000 new cases every year



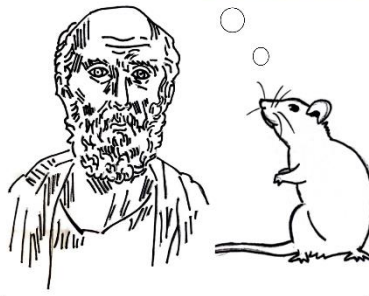
SCI is damage to the tight bundle of cells and nerves that sends and receives signals from the brain to and from the rest of the body. After the injury, many essential functions are lost or changed.



This is the first written evidence of paraplegia found in the Edwin Smith papyrus. It's the world's oldest medical record. SCI is described here as 'an untreatable condition'.



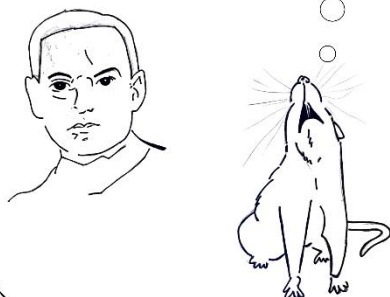
500-150 BC
SCI was identified by the Greek physician Hippocrates, known as 'father of medicine'.



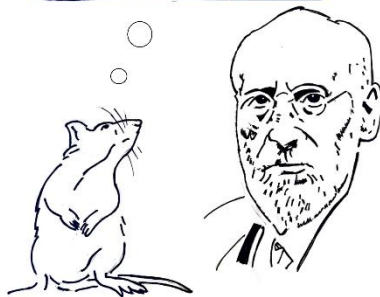
This is Hans Schmaus, the German pathologist, who established the first experimental model of SCI in rabbits in 1890s.



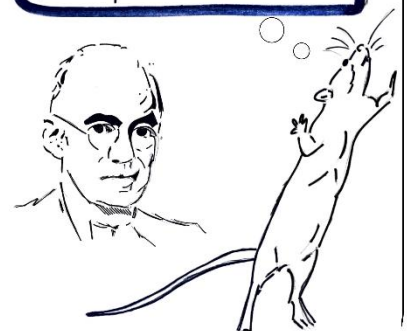
Alfred R. Allen, the American neurologist, improved the experimental model for paraplegia in 1911. It was essential for later research and is still in use today.



In 1928, Santiago Ramón y Cajal, one of the founding fathers of modern neuroscience, was the first who observed how damaged neurons at least try to regenerate, however, without success.



In 1930s, Donald Munro introduced the concept of rehabilitation and he built up a small department for SCI patients





In 1945, Ludwig Guttman, came up with better care for patients, thus increasing the quality of their lives. He is known as a father of the modern rehabilitation after SCI.



And finally, in 1968 Maurice Albin and Robert White reached the very first functional recovery in primates. Unbelievably, their approach is being tested in a clinical study as we speak



These men are Albert Aguayo and Sam David, they showed that axons can also regenerate in the CNS, if the environment is right. Their work from 1981 became the turning point in the SCI research.



Axonal regeneration in the rat spinal cord produced by an antibody against myelin-associated neurite growth inhibitors

Lisa Schnell & Martin E. Schwab*
doi:10.1038/343269a0

1990 in Switzerland, Lisa Schnell and Martin Schwab enhanced CNS regeneration by using antibody against one of the inhibitory molecules preventing axonal regeneration.



1990 brought another exciting finding. Jerry Silver was the first one who described how the glial scar - the scar over the injury site - prevents nerves from growing out again.



In 1991, the new hope for patients with chronic SCI appeared. John Houle' showed that axons can regenerate even long after SCI.



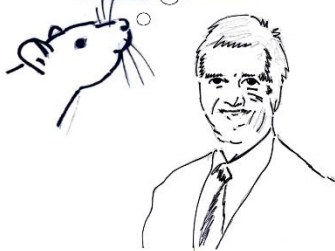
Patrick Aebischer manufactures the first biomaterial in 1995. He developed the first hydrogel into which neurons can grow.



Milan Dimitrijevic in 1998 showed that an electrical stimulation of the spinal cord can restore walking in paralyzed people



Stephen Strittmatter discovered the receptor that inhibits the axonal regrowth. These findings have got to clinical trials.



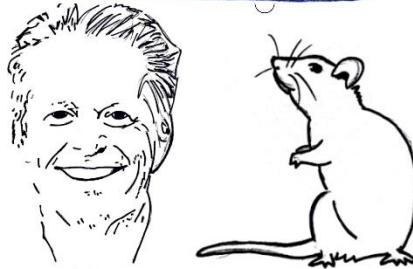
In 2002, James Fawcett and Stephen McMahon showed that special enzyme known as chondroitinase ABC enables glial scar softening.



Then in 2004, Martin Schwab described an ability that nerves have: form new links and connections in response to stimuli, called plasticity.



Hans Keirstead showed in his study from 2005 of stem cells can rebuild the missing sheath and thus restore function, due to their ability to develop into many different cell types.



Jan Schwab found out in 2007 that the immune system is affected after SCI, and therefore complicates recovery.



REGENERATIVE MEDICINE, VOL. 6, NO. 65 | INTERVIEW

GRNOPC1: the world's first embryonic stem cell-derived therapy

Jane Lebkowski

published online: 14 Oct 2011 | <https://doi.org/10.2217/rme.11.77>

In 2010, a clinical study tested the effects of embryonic stem cells.



Grégoire Courtine brought a new approach in SCI research. He introduced an electrochemical neuroprosthesis and a robot-assisted rehabilitation training to restore walking in rats after severe SCI in 2012.



In 2016, Michael Sofroniew showed that glial scarring plays a dual role. Without glial scar the axonal regrowth would be much more difficult.



2018, a year of SCI research milestones. Grégoire Courtine successfully restored walking in three incompletely injured patients owing to the electrostimulation he introduced in 2012. Moreover, Jerry Silver restored breathing functions in the model of chronic paraplegia.



2021

Dietmar Fisher enabled mice paralyzed after a complete SCI to walk by using a gene therapy.



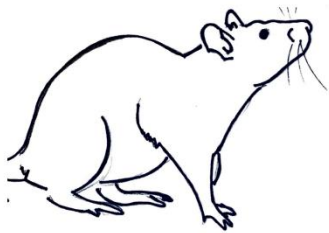
Leonor Saude showed that not dead, not alive senescent cells hold clues to SCI repair.



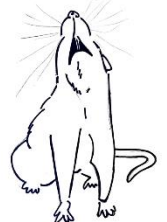
And Samuel Stupp published that injection of self-assembling gel that stimulates nerve regeneration into spinal cord, is a promising treatment for paralysis in mice.



In 2022, Michael A. Webb and Adam J. Gormley used AI and robotics to successfully stabilise the Chondroitinase ABC enzyme, one of the first times that AI and robotics were used to create highly sensitive therapeutic proteins.

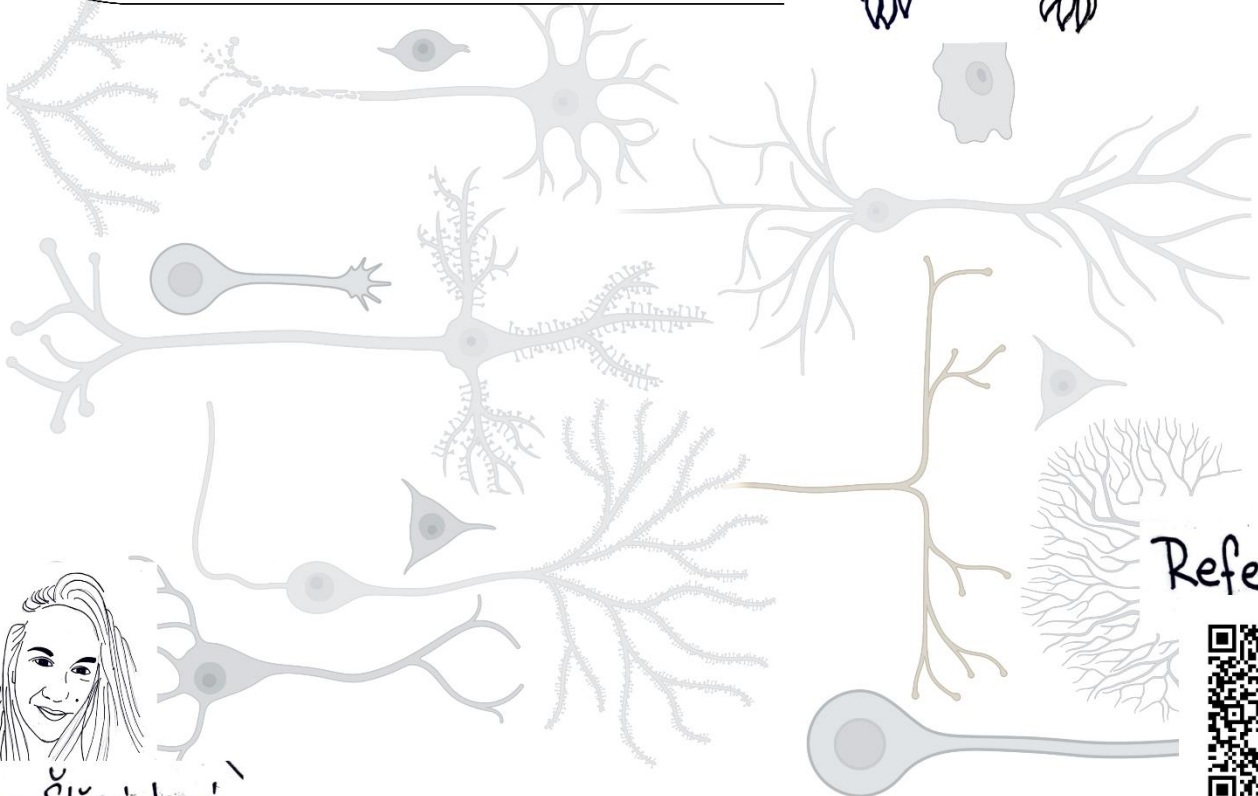
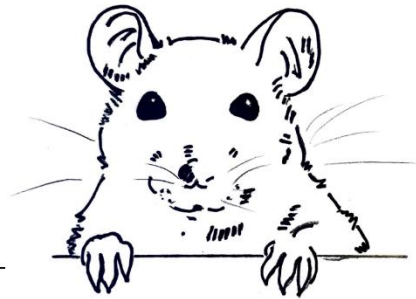


The year 2023 has been remarkable one, with breakthroughs in the treatment of SCIs offering new hope to patients thanks to Jocelyne Boch and Grégoire Courtine. Thanks to implants in his brain and spinal cord that translate his thoughts into movement, Gert-Jan Oskam, who was paralysed 13 years ago, can walk now.



And finally, in 2024, another thing that might give us some optimism is the set of international guidelines for the treatment of SCI that are due to be published at the beginning of this year. They should include evidence on the benefits of early surgical decompression in reducing pain, improving mobility and managing other symptoms such as bowel and bladder control.

Michael G. Fehlings said: 'We are really on the cusp of a remarkable era in regenerative neuroscience.'



References




Kateřina Štěpánková