A NERVOUS IMBALANCE
How spinal cord injuries destabilise unconscious functions (pg 2-3)

A BRIDGE TO RECOVERY
How wireless technology reconnects thoughts with movement (pg 4)

PIONEERING SURGICAL SOLUTIONS FOR SCI
Lt. Col. David Baxter on developing new treatments for paralysis (pg 5)

FANTASTIC FUNDRAISERS (PG 6) - MARKING MILESTONES (PG 6)
MEET THE TEAM (PG 7) - OUR LATEST AMBASSADOR (PG 7)
A Nervous Imbalance

How spinal cord injuries destabilise unconscious functions

The human body is comprised of 37 trillion cells, 206 bones and 600 muscles and this amazing machine is largely controlled through the world’s most powerful supercomputer – our brains.

However did you know there are a number of critical functions which operate in the background, helping to regulate and keep our bodies in balance?

These are controlled ‘automatically’ via the spinal cord and are known as autonomic functions.

What do we mean by autonomic functions?

For the majority of us, controlling our temperature is not something we have to think about. When we get too cold, our body has the ability to warm up. Likewise, when too hot, we sweat to cool down.

Temperature is just one of many unconscious processes controlled and stabilised by the autonomic nervous system (ANS).

The ANS is divided into two main systems: the sympathetic nervous system (SNS) and the parasympathetic nervous system (PNS) – the former responsible for responses to danger or during exercise, and is often referred to as our ‘fight or flight’ response. The latter controls many of our bodily processes during calm states helping us ‘rest and digest’.

The SNS and PNS are in constant opposition to each other, ensuring homeostasis – the dynamic feedback system to make sure bodily functions remain stable.

Working in perfect balance

In his recent Wimbledon final, new tennis champion Carlos Alcaraz’s autonomic nervous system would have played a vital role during his five-hour match.

His SNS would have increased his heart rate and blood pressure during critical points, and his PNS would have helped him relax and unlock the much-needed energy from his mid-match banana.

Working in harmony, these systems powered Carlos to the title.
How are these functions affected following injury?

Like all efficient systems, our autonomic system relies upon connectivity and information which is relayed from our bodies. This feedback loop tells the SNS and PNS whether to speed up or slow down certain processes.

Damage to the spinal cord at or above the level controlling these functions damages important connections and the result is that these functions are dysregulated.

This can lead to the inability to sweat, control blood pressure or temperature, as well as sometimes impairing breathing, all of which can cause serious health problems.

**Autonomic dysreflexia (AD)** is one of the most serious autonomic complications following SCI. This is where stimulation below the level of injury - for example a full bladder or skin damage - can trigger a sudden, dangerous rise in blood pressure (as pictured below).

92% of individuals with SCI above T6 will experience AD one year after injury, making it one of the most urgent issues to address.

If you experience autonomic dysreflexia, steps should be taken to understand the cause of the episode, and if necessary a medical professional consulted.

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**Autonomic Dysreflexia:**

The result of an imbalanced system

1. **Stimulus below the injury, like a full bladder, triggers a strong SNS response**

2. **Blood vessels are constricted, increasing blood pressure**

3. **The inhibiting PNS signals are blocked by the injury**

4. **Uninhibited elevation of blood pressure increases the risk of stroke**

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**The Role of Research**

Spinal Research has funded a variety of research projects and treatments which have increased our understanding of the Autonomic Nervous System, and investigated ways to improve these functions following SCI.

One of the key areas of focus is our ‘Below the Belt’ series of studies looking at bladder, bowel and sexual function.

For example we have several ongoing trials investigating the effect of electrical stimulation techniques to improve the ability of the bladder to store and empty correctly.

We are also funding research into improving cardiovascular function. This is being done through the use of a process called hypoxia. This exposes a patient to short controlled bursts of low oxygen intake.

Researchers have found that during these conditions the body responds by increased nerve regeneration in the network of neurons that control breathing.

**These treatments will help improve quality-of-life and will help reduce the risk of related conditions like autonomic dysreflexia.**
A Bridge to Recovery

How wireless technology reconnects thought with movement to overcome paralysis.

You may have seen recent articles and news coverage showing how scientists in Switzerland have created a “digital bridge” to help restore function after paralysis. The research combined the use of a brain implant with an implanted spinal stimulator in a patient who was injured over 10 years ago.

We take a close look at the research and explore its potential as a treatment for those with spinal cord injuries.

How does the technology work?
The study employed the use of two implants and a wireless decoder.
The initial implant was placed in the region of the brain which controls leg movements and communicated the brain’s electrical impulses to a special helmet. These sensors were able to monitor and wirelessly decode the electrical signals created by the brain when the patient thought about walking.
The second piece of technology employed was an implanted neuro stimulator placed over the region of the spinal cord which controls movements. A decoder acted as a “wireless bridge” transmitting the patient’s intention of movement in real-time to the spinal stimulator.

What are the results?
Combined with training and rehabilitation, the system “translated” the patient’s thoughts and intentions into movement.
Importantly, some of these improvements remained even when the “digital bridge” was switched off, suggesting that new nerve connections had been developed by the body.

What’s the potential for this technology?
Although in its early stages, this research shows the potential of using technology to restore function after spinal cord injury. Both the technology used, and our understanding of how the human body responds will improve, providing real hope that similar devices will deliver functional recovery to the SCI community.

How is Spinal Research helping to develop this technology?
Spinal Research has a number of studies in human trials, using similar electrical stimulation technology. We also are working with leading designers and manufacturers of stimulation devices to help progress the authentication needed to deliver these treatments safely to our community.

“While there is still much to improve with these technologies this is another exciting step on the roadmap for neurotechnology and its role in restoring function and independence to our spinal cord injury community”. Harvey Sihota, Chief Executive Spinal Research

Image supplied courtesy of ONWARD

Image supplied courtesy of ONWARD

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Did you always want to be a scientist, what did you want to do if not?

I have always been curious, and driven by a desire to change things for the better. This led me into medicine.

During my early years in the Army on tours in Afghanistan, I saw first-hand the devastating effects of brain and spine injury. These experiences have motivated me to further my knowledge on how we can repair and ultimately cure neurological injury.

How did you progress into your current position?

I am a military neurosurgeon. I studied Medicine at the University of Manchester, following which I joined the Army and completed officer training.

After medical house officer years and time on tour with the military, I began the long-haul of specialist neurosurgical training in London, during which time I also completed a PhD in Neuroscience at UCL.

Since finishing neurosurgical training, I have completed specialist trauma and spinal fellowships, leading to my current role as a Complex Spine Consultant at the Royal National Orthopaedic Hospital.

Can you tell us simply about your area of research?

I am the Surgical Lead for the London Spinal Cord Injuries Group. We are using spinal cord stimulation to improve function following spinal cord injury (SCI), in particular aspects of autonomic function like bladder and bowel function.

How can this help someone with SCI?

People living with SCI suffer from debilitating issues with bladder and bowel function. This is an area of significant concern for the SCI community.

In the short-term, we hope our research will lead to treatments that can improve continence, reducing the need for catheterisation and reducing UTI infection rates, as well as reducing daily toileting time and significantly improving quality of life for patients living with SCI.

What are the next steps for your research?

We are starting a trial over the next six months to see how to use epidural spinal cord stimulation to restore bladder and bowel function following SCI.

This research will also shed more light on the underlying mechanisms of bowel function and changes to the gut microbiome following SCI.

David is one of the first neurosurgeons in the UK to successfully implant a spinal stimulation device. He is also a Trustee for Spinal Research and recently completed a marathon swimming challenge around the Isle of Wight to raise funds for the charity.
Fantastic Fundraisers

Our pipeline of research is only possible because of the funding and support we receive from our supporters.

On a Mission to Cure Paralysis

In May, we held a special 007-themed charity gala evening at the Imperial War Museum North in Manchester.

Held to mark Spinal Cord Injury Awareness Day, guests were transported into the world of the secret agent with a champagne reception, three course dinner as well as poker, blackjack and roulette.

The evening was also supported by EON Productions Ltd, the official James Bond production company who supplied exclusive Bond merchandise and memorabilia for the online auction.

Attendees who supported the event included local firms Frenkel Topping, Slater Gordon, Irwin Mitchell, Cobden House Chambers, Deans Court Chambers as well as representatives from local hospitals, Spinal Units, other charities including Salford Rugby Foundation and BASIC, and disability advocate Martin Hibbert.

Altogether the evening raised over £30,000 for vital research into paralysis. Spinal Research would like to thank everyone who supported and attended the event.

We are planning similar events in the future, so please email events@spinal-research.org if you would like to find out more.

Marking Milestones for the Future

Anniversaries for Research

Everyone who suffers a spinal cord injury remembers when and how it happened. It’s a date of mixed emotions which comes round every year.

Andy was injured when he was a student, and used his 25 year “anniversary” milestone to thank friends and family who had helped him over the years. He also used the opportunity to help raise funds for research as he explains:

“I wanted to celebrate the things I had been able to achieve with the support of my network.

I also wanted to do something positive for research, and simply attaching a Facebook fundraiser to my social media message helped raise over £600 to help change the future for people like me living with spinal cord injury.”

Setting up something like a Facebook fundraiser for birthdays, events or marking milestones like Andy is simple and easy.

If you have Facebook, simply choose the “Fundraisers” button on your Facebook account and be sure to select: Spinal Research, or just use the QR code on the right to get started.

Alternatively, email fundraising@spinal-research.org for help and advice.
Meet the **Team**

**Lottie Dosanjh**  
Fundraising Assistant

**Could you tell us a little about your background?**  
During my time at university, I volunteered for two different charities. I loved these experiences, the people I met and how rewarding the work was! I decided I wanted to work in the third sector and began working for Spinal Research in 2022.

**Why is community fundraising so important to a charity like Spinal Research?**  
Spinal Research exists to find a cure for paralysis. We wouldn't be able to work towards this goal without our wonderful supporters, who go above and beyond to raise vital funds for research.

**What do you enjoy most about the role?**  
Meeting our wonderful supporters and seeing the amazing things they do for us is the best thing about my role!

From bucket collections to marathons, I have loved connecting with supporters. It’s also inspiring to see how the research is developing and moving forward through to clinical trials.

**Can you tell us more about the Roll for Research community activity?**  
Roll for Research is our brand new, fully inclusive challenge month happening in September! We are asking supporters to take on a rolling challenge to raise vital funds for research.

Whether you use a wheelchair, bike or skateboard, everyone can join #TeamSpinal and support Roll for Research!

**Do you have a message for our supporters and how they can reach you?**  
We would love you to get involved! You can join us for our train station collections or hold your own collection at a local venue.

We have plenty of challenges you can get involved in such as overseas challenges or Roll for Research. You could also fundraise your own way by holding your own quiz night, sweepstake or bake sale. Whether you know what to do or you want ideas, I would love to hear from you!

**What do you do in your spare time?**  
I like doing something creative like cooking or painting, or socialising with friends!  

Email Lottie@spinal-research.org for support, guidance or to say hi!

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**Introducing Issy**  
The latest member of our Ambassador family

Issy was just nine years old when she was involved in a serious car accident, resulting in her suffering a spinal cord injury at C1. Unfortunately, being injured at this level has meant that Issy is unable to move from the shoulders down, and uses a ventilator to help her breathe.

Despite these challenges, Issy completed her A-level studies, has a degree in French and linguistics and is currently doing a Masters in English literature.

As well as her love for learning and teaching, Issy is a passionate supporter of Spinal Research and is looking forward to raising awareness of our work through her role as an ambassador:

“I’m now excited for my journey to start contributing to Spinal Research. I hope to help the advancements in curing paralysis in any way i can.”

**Spinal Research Ambassadors Programme**

As a small charity, our growing family of ambassadors play a vital role in championing our work. This may be with their local community, through their personal and professional network or even online.

If you’re interested in finding out more about becoming an ambassador please email suzanne@spinal-research.org

Find out more at spinal-research.org/ambassadors or call us on 020 3824 7400

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Fundraise Your Way
Fundraising isn’t just running a marathon - we have dozens of events for all ages and interests. Here are some ideas to get you started!

The Big Bakethrough
It’s a classic fundraiser for a reason. Get everyone baking and raise some dough.
Download our new special bake pack at: spinal-research.org/bake

Take On a New Challenge
From skydiving to completing a Northern Lights Winter Trek, there are loads of exciting ways you can help raise funds.
Take a look at the options at: spinal-research.org/challenge

New Fundraising Pack
Stuck for ideas? Take a look at our new fundraising pack, full of ideas and guidance to help you raise vital funds for research.
Download your pack at: spinal-research.org/yourfundraising

Dates for your diary
Activities to look out for in 2023/24

- 14-16/9/23 ISRT Research Network Event
- 1-5/10/23 Alpine Challenge
- 18/10/23 Wetherby Race Day, Yorkshire
- 21/4/24 London Marathon

Christmas is coming!
Order yours now using the catalogue enclosed.

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