



Colm Campbell is a mechanical and electrical engineer whose personal experience with back pain has led him to develop the ZS chair, which offers an innovative solution to sufferers. Here, he explains how he developed what he describes as a major breakthrough in the treatment of back problems and he offers some advice for other engineer-entrepreneurs

Back pain

an engineer's solution for a chronic condition

As a back pain sufferer myself, I have been researching back pain, its causes and prevention for over 25 years and have published a book on my findings, *The Engineering Solution to Suffering Back Pain*. Sitting with bad posture is by far the most common cause of back pain. In the seated position, the spine slumps into a "C" shape, creating a large bending movement and resultant huge pressure in the intervertebral discs.

The shape of the spine is an elongated 'S' and every spine has its own unique 'S' shape. So much so that I've coined the expression 'backprints are as unique as fingerprints'. When the spine is in its 'S' shape, there is the least possible pressure on the intervertebral discs. It is extremely important to realise this fact, as it is the basis for living pain-free. I have designed and patented a system, Spinal System-S, a method for manufacturing custom tailored office, home, and car seats that guarantees perfect posture. Out of a total of some 10,000 back pain sufferers that have availed of the system, it has resulted in 9,500 sitting pain-free for at least seven hours at a time. This 95 per cent success rate is due to the fact that the system enables users to always sit with perfect posture, which in turn ensures the least possible pressure on the intervertebral discs.

Eliminating pain

Eliminating back pain can be a long process and, in most cases, can only be achieved by the back pain sufferer. Experts, such as physiotherapists, osteopaths etc, are very successful at treating pain but they are only relieving the symptoms, not the causes. Only the individual sufferer can do this. I have personally interviewed approximately two thousand people who have undergone invasive back surgery. The percentage of successful operations is less than one percent.

A history of back problems

Without determination and a knowledge of spinal anatomy you are never going to be pain-free. My own history of back problems brought me to this conclusion. I had originally damaged my spine as a sixteen year-old playing rugby. I continued to play contact sport throughout my twenties while always suffering bouts of pain. Then, 25 years ago, I ended up being taken by ambulance to hospital with a ruptured disc.

In hospital, the day before my scheduled operation, I refused to have it. This turned out to be the wisest decision I ever made, although, at



the time, wisdom didn't come into it. It was based on the fact that a patient in the bed next to me was in greater pain after the operation than before. At home, in excruciating pain, I decided I would have to help myself. but I had no knowledge of spinal anatomy. I set out to rectify this and within a short time I learned, in theory, how the spine works. I then set up a bench experiment to simulate the lumbar spine.

Using five children's wooden building blocks to represent the vertebrae, I inserted household jelly between the blocks to represent the discs and screwed two strips of bicycle tube under tension into the front and back of the blocks to represent the anterior and posterior longitudinal ligaments. Next, I bent the 'lumbar spine' into a forward 'C' position and observed the jelly bulging backwards on either side of the 'posterior longitudinal ligament.'

My crude experiment demonstrated the main cause of back pain whereby bulging discs can make contact with adjacent nerves and cause pain. A Swedish study proved that sitting with bad posture creates more pressure in the lumbar spine than any other body position; 250kg/sq cm as against 125kg/cm with perfect posture, 200kg/cm bending forward to lift, 125kg/sq cm standing with bad posture, 25kg/cm lying flat on back. I reckoned that if I sat with perfect posture my slipped disc might break contact with a nerve and I would be pain-free. I made a simple jig that provided the information necessary to make a car support that gave perfect posture and some nine weeks after leaving hospital I was able to drive to work. In pain, yes, but bearable pain.

The ZS chair project

The ZS project, which built upon the principles outlined above, came about primarily because of the encouragement and persistence of a close friend, Frank McCabe (ex-Intel). Long before the recent economic downturn, he had been warning me, with remarkable foresight, of an imminent recession. Although I was initially skeptical, he argued repeatedly and persuasively that for my business to survive and grow in the face of a downturn, I needed to develop a signature product with the potential to appeal to a mass market. So almost two years ago he convinced me that it was time to take action and I set about designing a chair that would be of benefit to all (young and old, healthy and infirm), and capable of being sold on the global market. I tackled the project in a logical way. My concept, the ZS chair (where Z=zero gravity and S=perfect posture) would tackle the fundamental issue at the core of back problems - gravity. Gravity causes back pain so, the chair would have to provide a zero gravity effect.

I experimented with a number of ways of achieving this; one used a disc brake to lock the chair in any position from upright to horizontal. I made this into a feature by using a ten-inch porthole with a brass clock face for viewing the mechanism, but as it was manually operated, and required some effort, it would be unsuitable for some people. I decided to use a 24V actuator, capable of lifting 450kg, allowing the chair to be reclined from upright to horizontal and fixed in any of 256 positions. The tubular metal frame, with the leg rest permanently bent at an angle of thirty degrees, rotates on

ball bearings. In the fully reclined position with the knees elevated above the torso (see photograph) there is zero gravity acting down the spine with the least possible force acting on every organ and joint of the body thereby improving the rates of recovery for many ailments, including cardiac and vascular conditions. It will greatly improve the quality of life of long-term patients and give a sense of independence to the incapacitated. It is particularly effective for sports; speeding up recovery rates from injuries and bouts of intense physical activity.

Global availability

Having developed the ZS product, I assumed that exporting was impossible as the measurement procedure was 'hands-on' and required the person with the back problem to be present. Then, it occurred to me, why couldn't it be exported?

Once I posed the question, I quickly developed a system that allows me to export the ZS chair anywhere in the world. Each ZS now comes with a patented Dup Kit, which allows customers via a simple process to make the final modifications to ensure the chair duplicates the unique contours of their own 'S'. This process takes only minutes to complete. The self-questioning that led to the development of the Dup Kit provides, I believe, a valuable lesson for engineer-entrepreneurs. Question all aspects of your business, even what you consider to be obvious.



Colm Campbell Chartered Engineer has a degree in mechanical and electrical engineering. After studying in UCD, he did an apprenticeship in the UK. He worked in Bord na Móna, Irish Lights, CRH and The Irish Times before forming his own company, Spine Design Ltd, which designs products for back pain prevention. In 2007, he published a book on his research. The ZS chair will be sold by medical, sports and department stores (it is now on sale in Brown Thomas in Dublin) in various countries, as well as online. In addition, one of the top four English Premier League clubs is a ZS customer.

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