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sports injury pain

Sports Injury Pain : Pain and brain - a revolutionary approach to chronic injury

Injury and pain are a competitive athlete's worst nightmare, scuppering even the best-laid training plans. And when injuries become chronic, they can destroy confidence and even end athletic careers. But a revolution is taking place in our understanding of pain, which has profound implications for the treatment and rehabilitation of many chronic injuries. As Stephen Robson and Louis Gifford explain in the first of a two-part series, it's time to throw away many of our existing preconceptions about pain and injury.

At a glance:

- New research shows the brain and central nervous system are wholly involved in the processing of pain signals in the body;
- The pain you experience is hugely influenced by your individual psychological, biological and sociological make-up;
- The amount of pain you experience when injured may be quite unrelated to the extent of your injury;
- Chronic pain is often caused by inappropriate nervous system activity – not by tissue damage;
- These findings are leading to a revolution in the way physiotherapists will treat many chronic injuries in the future.

The trouble with pain is that it is normal to hurt. In fact to be more specific, pain is an evolutionary masterpiece that protects us from injury by alerting us to actual or perceived threat or damage to our tissues. However, until recently all of the various orthodox and alternative branches of medicine have understood very little about pain and consequently how to treat it (see box on 'The history of pain' below).

The history of pain

The last 10 years have seen more progress in our understanding of pain than the entire preceding history of medicine. This explosion of 'pain knowledge' has been, in medical terms, equivalent to discovering that the world is round and not flat.

Before this recent period of 'pain discovery', treatment for painful conditions was largely based on tradition, faith and guesswork. A vast array of orthodox and alternative pain treatments became available throughout this period and many continue to be used today. Medical doctors, physiotherapists, osteopaths

and chiropractors right through to crystal therapists have all presented their theories and philosophies regarding their particular approach to treating pain.

Because these professions emerged before the current scientific evidence was available, and at a time when there was little if any evidence on which to base treatment approaches, the result was the development of therapeutic approaches based on theories and philosophies rather than reliable scientific evidence. On reflection it is probably unsurprising to learn that throughout this time the success of treatments for painful conditions has in scientific terms been modest to disastrous.

Until recently many of the theories behind pain treatments were based around the work of a 17th century French philosopher named René Descartes. Descartes believed that the mind and body operated separately and as such, pain signals followed a single pathway straight from the damaged body part to be registered consciously in the brain.

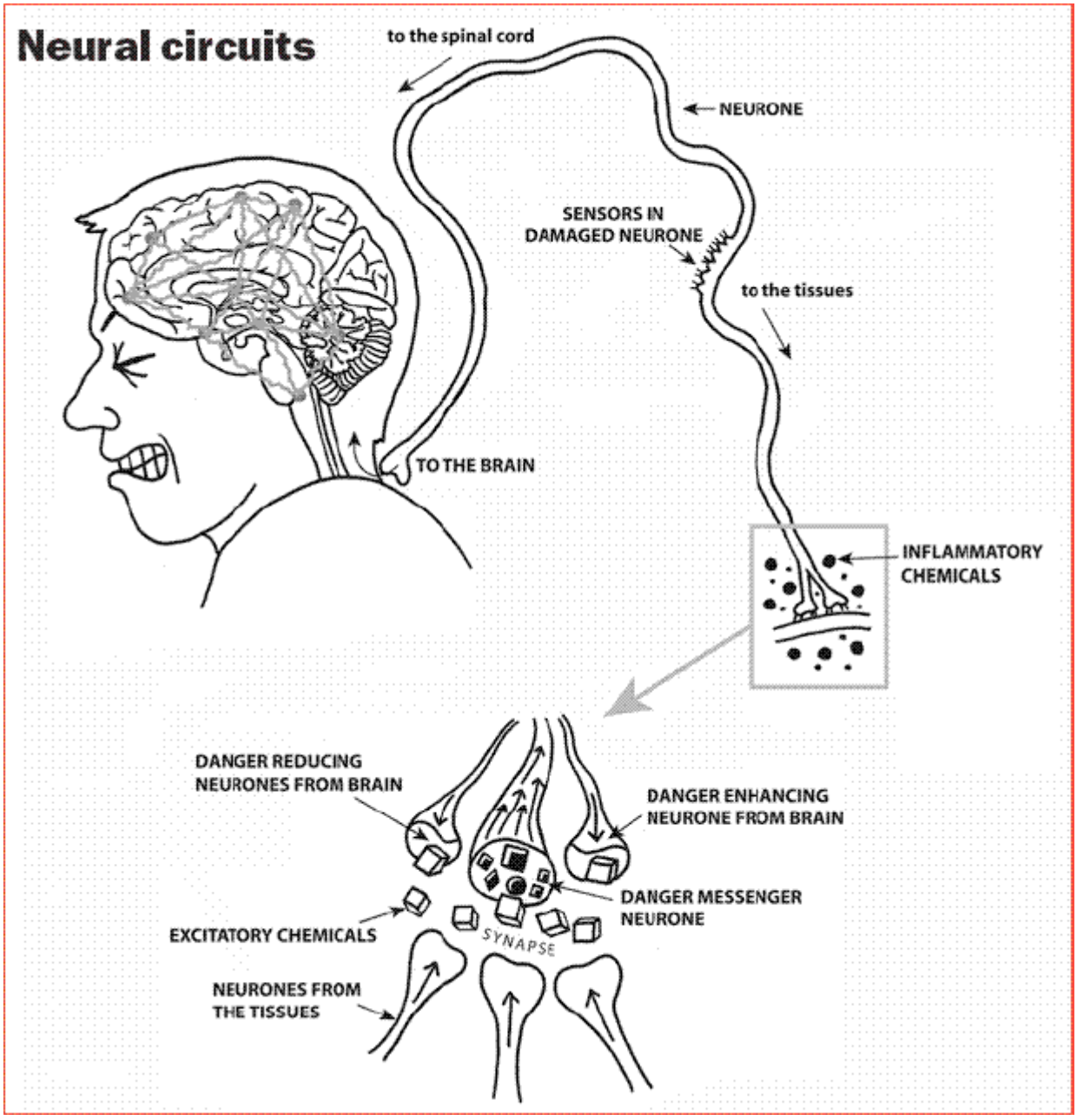
It has taken almost four centuries for medical science to establish enough evidence to know that Descartes was wrong. We now know that the brain is wholly involved in the processing of pain and is actually the major control centre when it comes to pain. Finding this out has been hugely important in our current understanding of pain and how to treat it.

We now know that pain is a multi-dimensional amalgamation and integration of biological, psychological and sociological factors. In the same way that differences in our individual biology, psychology and social circumstances make us individual and who we are as people, these factors also influence our experience of pain. To understand why this is so, we first need to understand some basic facts about pain.

Surprising facts about pain

Pain involves complex neural circuits (see diagram below) from the tissues of the body into the central nervous system/brain and back out again. Therefore, all pain involves the brain. Pain influences the brain, the brain influences the mind (a convenient collective term for those states of brain activity involving awareness), and the mind and brain combine to produce a response. Hence how an individual interprets and reacts to pain has a very powerful influence over the pain and its outcome.

Neural circuits



Sensory information is processed and interpreted by your central nervous system. This requires highly complex brain functions involving scrutiny of past experiences, knowledge, beliefs, culture, past successful behaviours and successful behaviours observed in others [(1)].

So for example, take exactly the same type of injury occurring at the Achilles tendon of an office worker and a professional footballer. The office worker may interpret this injury as nothing more than an irritating discomfort; however, in a footballer this same injury may be interpreted as a threat to their

fitness, career and livelihood and thus 'negative reaction' or appraisal can lead to more pain and even a slowing of recovery rate.

Pain is not an isolated reaction in the tissues that are injured or that hurt – ie you can't feel anything without a brain (no brain – no pain!). There is also a psychological reaction in everyone who feels pain and this drives subsequent behaviour, affecting outcomes. For example, a runner who experiences pain in the back of their leg while running may respond to this pain in the following way:

- 'I've never had pain like this before' (past experience);
- 'Sciatica causes pain down the back of the leg but so does a hamstring strain' (knowledge);
- 'I've heard that you can't really get rid of sciatica' (beliefs);
- 'I won't say anything to my training partner – I'll keep a stiff upper lip and just keep running' (culture);
- 'Maybe I should see my doctor, those pills he gave me for my calf pain last year really helped' (past successful behaviours);
- 'My brother went to see that physiotherapist in town and he sorted his hamstring strain out' (past successful behaviours observed in others).

The outcome in this example is that the runner makes an appointment to see the physiotherapist – ie a behaviour driven by the psychological reaction to the leg pain.

More suprising facts

Pain is very commonly not a reliable witness to the extent of injury or tissue damaged. For example, sciatica (a condition that may disable an athlete) can lead to huge amounts of pain experienced from a tiny area of tissue injury. At the opposite extreme, spinal disc bulges/herniations are known to occur and exist without causing any pain whatsoever [2,3].

In fact, most if not all of us have experienced examples of tissue damage occurring without pain. For example, have you ever wondered how you could have failed to feel pain from that bruise or cut you didn't even notice was there until you discovered it while showering?

Bruises and cuts are obvious signs of tissue damage yet often do not produce pain at the time of injury. In these circumstances the central nervous system has received the tissue injury signals from the cut or bruise, scrutinised them and decided that the area will recover without necessitating any changes to your behaviour. Therefore no pain is required to make you rest, limp etc (ie behave differently) to help allow the tissue to heal.

Contrary to popular belief, most injuries affect multiple structures, eg back strains. The idea of a single tissue culprit being the source of pain may be untenable [2].

Injury and disease processes obviously change the state of tissues. However, if pain is a feature of these processes, it usually starts as a result of mechanical and chemical influences in the tissues activating nociceptors (nociceptors are nerve fibres normally dedicated to sensing intense or threatening stimuli). For example, an acutely twisted ankle or calf tear results in mechanically derived damage to the tissues involved, followed by inflammation and the subsequent chemical irritation of local nociceptors.

Stopping the activity of the nociceptors that serve the area of tissue damage at a time near the onset of pain, using agents such as local anaesthetic, will completely obliterate the pain (it stops the dominoes toppling – see below). Stopping or curtailing inflammation may dull nociceptive activity enough to take out a proportion of the pain too. This is how non-steroidal anti-inflammatory drugs such as ibuprofen work.

Injury or irritation of peripheral nerves and nerve roots (the bulbous part of the peripheral nerve just outside of the spinal cord) can also be a starting point for pain, eg acute sciatica. One commonly recognised initial cause of sciatica is that of spinal discs herniating/bulging out onto the sciatic nerve. However, surgically removing or altering the offending disc will often fail to stop an irritated nerve from causing pain, even though the disc may have initiated the process [2,4].

Domino effect

The neurophysiological reasons for this are extensive and beyond the scope of this article. However, you can think of the ongoing process of pain as akin to a 'domino effect'. Imagine a line of dominoes, where the first domino in line represents tissue injury (disc, nerve, ligament, muscle etc), the second represents the nociceptor and further dominoes represent all of the subsequent nerve connections right up into the brain.

If the first domino is toppled (signifying tissue injury), this causes each domino in turn to topple all of the way down the line, just like a sequence of nerve signals from the tissue going up to the brain.

Hopefully, you can also see from this representation that, just like pain, even if you stand the first domino back up again (the equivalent of surgically removing or treating the offending tissue) this would not stop or reverse the rest of the dominoes toppling, and therefore the signal can still continue onwards to register as pain in the brain.

These signals can continue to reverberate within the central nervous system long after tissues have healed. This is part of the reason why many people, including athletes, still continue to experience pain even after they have undergone surgery to remove injured tissues like discs or cartilage, or after they have received treatments to help injured tissues to heal.

We now understand that most persistent, ongoing pain associated with an injury is driven and maintained by mechanisms and changes that occur within the 'circuitry' of the central nervous system as a result of injury and that this is often not a sign of any active ongoing tissue injury. In simple terms, it's quite

possible to have ongoing pain without any actual tissue damage and therefore ‘hurt does not always mean harm’ in the same way that ‘harm does not always mean hurt’.
This helps to explain why the treatment of chronic pain resulting from injury is so frequently unsuccessful; the original injury may already have healed and it’s the circuitry of the central nervous system that really needs attention.

When pain is not benign :

Although most chronic pain is benign, we must always be aware that a very small but significant percentage of people with pain do have serious underlying disease or pathology causing it. For example, although it’s extremely rare, chronic pain could be an indication of tumour, infection or fracture.
Screening for serious disorders is a highly skilled part of the examination process, and a detailed history, physical examination (and sometimes a referral to other medical experts) are essential to rule out more sinister causes of pain.
It is therefore imperative when seeking help for painful conditions that whoever you are consulting is properly medically qualified and trained to do this and your physiotherapist should be state-registered as a minimum. Physiotherapists who are members of the Physiotherapy Pain Association (PPA) have a specific interest in treating pain, and have often done additional post-graduate training in this area. More information is available at www.ppaonline.co.uk.

Maladaptive and chronic pain

All this means there’s good news for many athletes with chronic injuries; firstly, hurt does not necessarily equate to harm’ and secondly, there is such a thing as maladaptive (biologically unhelpful) pain. You can think of maladaptive pain in terms of ‘active aberrant pain circuitry’ that remains switched on in the central nervous system long after tissues have healed.
Unlike ‘new’ acute pain, ongoing maladaptive pain does not help recovery because it doesn’t produce behavioural changes that allow healing. This is because the tissues involved have already healed to their maximal potential long ago and therefore the remaining pain is ‘useless’.
Hence the problems with therapy approaches that over-focus on finding a specific source of pain – fine for fixing a car but far too simple for fixing complex human pain states. For example, focusing on joints by manipulating or mobilising them, or on muscles by strengthening or stabilising them loses sight of the bigger picture. The source of much of the long-lasting pain associated with chronic injury is likely to be in the central nervous system – not in the tissues.

The tissues that hurt may only play a small part in the pain, if any. This makes continued therapeutic focus on those tissues that hurt, at best, only moderately effective and possibly ineffective or detrimental.

Implications of maladaptive pain

The new understanding of pain, particularly chronic maladaptive pain, is revealing major shortcomings in conventional treatment therapies (where a specific tissue is treated). For example, as time passes, the original cause of the pain may become irrelevant. Thus, while a spinal disc injury may precipitate a back pain or sciatica, as time passes its state may be far less relevant to the pain.

It's also incorrect to reason that if a therapy targeted at a particular structure is successful in alleviating the pain, then that structure has to be responsible for the pain. For example, if a therapist mobilises the joints of a patient's neck and the patient's elbow pain improves, the traditional reasoning assumes the neck joints as a likely or potential source of the pain because this is the level where the nerves to the elbow emerge from the spine. However, pressure on the foot (reflexology for example) or ear lobe (some forms of acupuncture) could have achieved the same thing, and sometimes does if the therapy can be set up to be acceptable in the eyes of the patient.

In the same way, surgical removal of spinal disc material with a subsequent alleviation of pain does not necessarily mean that the disc material was the source of the pain. There are many examples in medical literature where surgeons have performed exploratory surgery alone on the low backs of patients who, following their surgery, have reported relief of their back pain and sciatica. In plain English, anaesthetise a patient, cut them open, dig around a bit, have a good look, find nothing of interest, sew them back up again – and about 40% will be completely relieved of their symptoms [(5)].

Effective pain treatment

We also know that if pain changes quickly with treatment, the most responsible explanation for the mechanism of the effect is that it is down to changes in the processing of information in the central nervous system. However, treatments for pain are likely to be much more effective in both the short and long term if they are based on the biological and psychosocial factors that science has identified as being integral to everyone's experience of pain. Remarkably, it seems that pain can often be treated from anywhere in the body – any of a number of techniques that successfully interact biologically or psychologically with a patient can be effective in modulating pain.

In the second of this two-part series, Stephen and Louis illustrate how this radical 'biopsychosocial' approach to pain can be applied in practice to treat chronic injuries in athletes. Two case studies are presented, involving successful treatment of chronic neck and arm pain in an elite golfer, and hamstring

pain in an elite rugby player. There'll also be information on how to spot the telltale signs of neurologically produced pain, and how to distinguish it from acute pain associated with actual tissue damage. Finally Stephen and Louis will discuss how this new, evidence-based approach is forcing us to re-evaluate some of the current treatment approaches to chronic neck, shoulder and back pain, such as core stability training, and why some of these current approaches may even be counterproductive in the longer term.

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