Rethinking the root of chronic headaches

Chronic headaches are a leading cause of health burden worldwide and are debilitating for people living with the condition. Pamela Blake, MD, Director of the Headache Center of River Oaks, and Carlton Perry, MD, River Oaks Plastic Surgery Center, are exploring the underlying cause of the condition in the hope of finding ways to provide patients with relief from constant pain. Recently, the research team has focused on how nerves in the neck could be the root of this pain, challenging the belief that all headaches have their basis in the brain or even inside the skull.

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Almost all of us experience headaches time to time – normally an unpleasant however thankfully short-lived experience. For some, however, headaches can be excruciating and last weeks and even months, with patients living in continual pain. Chronic headaches can have a huge impact on quality of life for those who experience them, yet unfortunately there remains a dearth of treatments available for patients seeking relief. Some neurologists assert that this is partly because so little is understood about their cause and physiological basis.

Pamela Blake, MD, is a trained neurologist with decades of experience in Headache Medicine. Together with surgical colleague, Carlton Perry, MD, of River Oaks Plastic Surgery Center, the researchers are focusing on understanding the causes of headaches and the best ways to overcome symptoms. Over the past years, they have worked with collaborators to offer a new way of thinking about – and potentially treating – chronic headaches.

NOT ALL HEADACHES ARE CREATED EQUAL

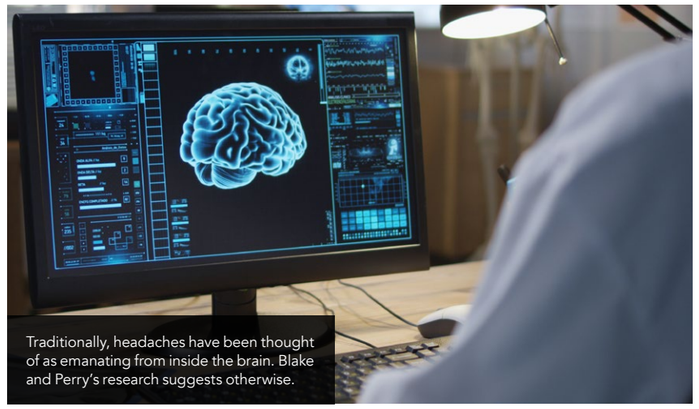
Traditionally, headaches have been thought of as emanating from inside the brain, with much research and treatment centred on what could be done to relieve pain based on structures and areas inside the skull. Medicines that are typically available for patients have included antidepressants and anticonvulsants, which exert their effects on the brain and can come with unacceptable side effects and low effectiveness. Recently, however, there has been a wider acceptance that chronic pain could in fact be coming from peripheral areas outside of the skull.

Distinguishing between headache types is crucial to understanding its origins, and ultimately to treating the pain. When patients come to Dr Blake's clinic, they are assessed in detail not only for the characteristics of their pain and other physical experiences but also for cognitive symptoms and emotional well-being, as involvement of these domains may have an impact on headaches. Cognitive symptoms in particular can also affect the sufferer's ability to describe head and neck pain, and, if unaddressed, will interfere with crucial aspects of symptom description to such a degree that vital insights to pain etiology may be missed.

One symptom that is often mentioned is the neck pain that goes alongside the headache. It is this neck pain that is commonly experienced by patients that led Dr Blake to focus her attention on the neck area and how it could play a causative role in the headache.

ESTABLISHING THE PHYSIOLOGY

Dr Blake and Dr Perry investigated the role of the extracranial (outside of the skull) structures in areas linked to the pain that Dr Blake's patients described. They built their understanding of how extracranial structures might play a role in head and neck pain based on foundational work completed by their colleague, Dr Rami Burstein. Dr Burstein showed in mouse studies in 2009 that nerve fibres on the outside of the skull cross the skull bones before connecting to intracranial meninges – membranes that cover the brain and spinal cord. This important discovery had established the significance of areas outside the skull in the role of pain that may be perceived as coming from inside the skull, as well as involving features that had been considered to be indicative of intracranial pathology. It also suggested a mechanism by which treatments that target the neck and extracranial muscles, such as Botox, may offer relief from headaches.



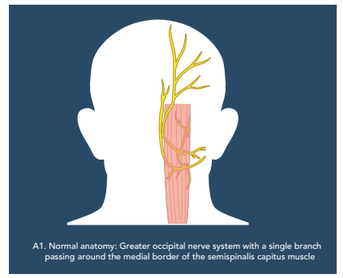
Traditionally, headaches have been thought of as emanating from inside the brain. Blake and Perry's research suggests otherwise.

Previous researchers, particularly Dr Bahman Guyuron, had identified that compression of nerves in the neck and on the outside of the skull could cause pain, and that surgical decompression of the involved nerves could reduce pain. Earlier studies of the condition of nerve compression were of limited utility due to incomplete understanding of the pathophysiology and of inadequate characterisation of the types of headache that patients experienced. Drs Blake and Perry were interested to add clarity to the science. In 2016, Dr Blake and Dr Perry showed that there is localised inflammation on the outside of the head in some people living with chronic headaches who also experience neck pain. In ground-breaking research, Dr Perry took biopsies from these patients at the site of the pain in the head, removing a small piece of what is called the calvarial periosteum – a layer of connective tissue covering the skull. Dr Burstein then completed DNA studies of the tissue, comparing the samples from headache sufferers to non-headache control subjects, and showed an uptick in expression for genes linked to inflammation and a decrease in immune-suppressing genes – a pattern that was not seen in the people without headache. This was the first, firm evidence that the pathology of headaches can be seen outside the skull and is directly linked to extracranial pathology. Moreover, it helped elucidate the role of inflammation in people with neck muscle tenderness and chronic headache.

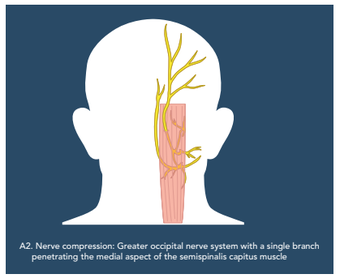
UNREMITTING HEAD AND NECK PAIN

In a recent review, Dr Blake and Dr Burstein set out the evidence of pathophysiology of occipital nerve compression in chronic head and neck

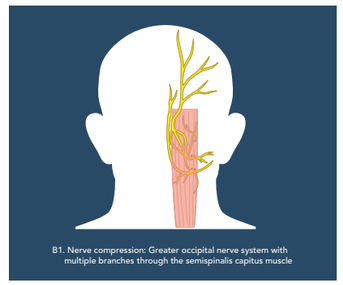
Neck pain frequently mentioned by patients led the researchers to focus attention on how the neck area could play a causative role in headaches.



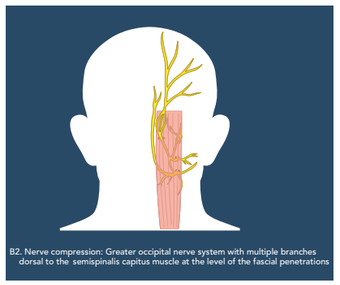
A1. Normal anatomy: Greater occipital nerve system with a single branch passing around the medial border of the semispinalis capitus muscle



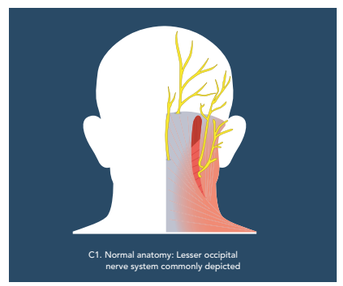
A2. Nerve compression: Greater occipital nerve system with a single branch penetrating the medial aspect of the semispinalis capitus muscle



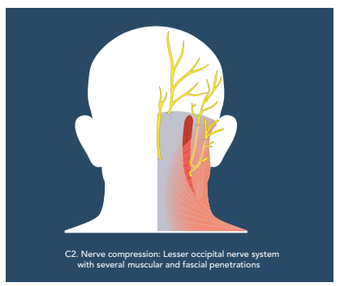
B1. Nerve compression: Greater occipital nerve system with multiple branches through the semispinalis capitus muscle



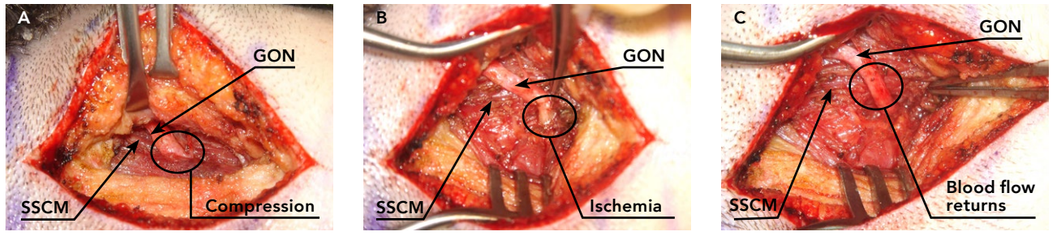
B2. Nerve compression: Greater occipital nerve system with multiple branches dorsal to the semispinalis capitus muscle at the level of the fascial penetrations



C1. Normal anatomy: Lesser occipital nerve system commonly depicted



C2. Nerve compression: Lesser occipital nerve system with several muscular and fascial penetrations



A. The greater occipital nerve (GON) runs through the semispinalis capitus muscle (SSCM) muscle. Compression to the GON causes inflammation and inflammatory tissue squeezes GON until blood flow stops (lack of blood flow results in the white appearance of nerve). GON starts to die and causes pain. B. Loss of blood flow to the nerve (ischemia). C. Removal of inflammatory tissue relieves pressure on the nerve. Blood flow returns, nerve is no longer white and pain signals stop.

pain. They believe that these nerves – running from the back of the neck to the back of the head, and then, potentially by connections with the nerves that travel through the skull to the meninges – could be central to unremitting head and neck pain (UHNP). This theory proposes that UHNP, at least in some patients, stems from compression of nerves by muscles in the back of the neck and the fascial attachments of those muscles to the skull at the occipital skull at the back of the head. Localised inflammation occurs secondary to the compression, causing pain in the occipital part of the head that can radiate via the connecting nerves that travel through the skull and thus radiate to other parts of the head, causing more widespread headaches.

Patients who have UHNP often report symptoms including allodynia – painful sensations that are caused by normally non-pain inducing stimuli, such as lightly touching the face. It also shares some symptoms of migraine, including sensitivity to light. The research team suggest that UNHP should be thought of as a subgroup of chronic headache and of other headache types, including migraine.

Patients describe a constant discomfort, a feeling of tightness in the back of the neck, and intense bouts of pain that radiate to the front of the head around the temples and forehead. For some, the pain is so constant they become used to it, stop noticing the mild neck discomfort and might not report it to their clinician. Many patients struggle to manage their condition and there are few treatment options available.

NERVE DECOMPRESSION SURGERY

Nerve decompression surgery involves removing compressive inflammatory tissue and muscle from the underlying nerves thought to be involved in the headaches. It has attracted debate previously, because it has had mixed results in studies conducted without careful characterisation of headache types by a qualified neurologist, and also with uneven results when the procedure was performed by inadequately trained surgeons. Additionally, there is a dearth of research around it. Furthermore, research into the effectiveness of surgical procedures is limited due to the absence of a control group. However, the case for treatments that look beyond the skull is growing. As headache types very between patients, it may be that surgery will only benefit those patients with a particular type of headache, and such patients must be carefully identified. A recent case study report of seven patients showed that there was significant benefit for four patients, but only limited or no pain relief for three patients. All patients had different headaches types, reiterating the importance of better understanding of individual cases. The challenge therefore is predicting who will best be served by the surgical intervention. Dr Blake and Dr Perry thus suggest that surgery may work in certain cases, and their experience is that for these individuals, the surgery may be life-changing.

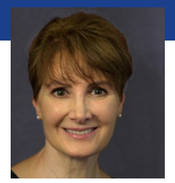
Nerve decompression surgery could be a game-changer for people living with chronic headaches.

In addition to improving the process of identifying candidates for nerve decompression surgery, Dr Perry has refined surgical techniques to ensure adequate decompression of all involved nerves. Together, Dr Blake and Dr Perry compare clinical and surgical findings with their eye on after-care and work closely with physical therapists and psychologists to maximise the chances of improved quality of life for patients after surgery. They believe that nerve decompression surgery could be a game-changer for people living with chronic headaches and that this new way of thinking about headaches could dramatically impact how patients are treated. It has also become clear that identification and treatment of co-occurring conditions, such as anxiety and neck muscle spasm, are very important. Given that there are so few treatment options available, the findings clearly support a position of gathering more information on who could benefit from this potentially life-changing intervention.

LOOKING TO THE FUTURE

Millions worldwide live with chronic headaches, and as the cost of disability associated with headache rises, there is further need to understand more about how to tackle the issue. This translational work has shown that for at least some patients, the neck is the key origin of pain. The evidence Dr Blake and Dr Perry are building provides a clear argument that structures outside of the skull and localised inflammation should be thought of as key to some forms of headache. Whilst nerve decompression surgery research is in its infancy, it could bring huge relief for a subset of people living with chronic headache. Headache research is ongoing and promises to offer some hope to patients living with this debilitating condition.

Behind the Research



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Research Objectives

Pamela Blake and Carlton Perry work closely together to further awareness of nerve compression as a cause of chronic head and neck pain.

Detail

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Bio

Pamela Blake, M.D. completed residency in Neurology at Georgetown University in Washington, DC, and fellowship in Neuro-Ophthalmology at the Johns Hopkins Hospital in Baltimore, MD. She is UCNS-certified in Headache Medicine and is an Adjunct Associate Professor at the McGovern School of Medicine, University of Texas Health Science Center Houston, where she serves as Director of the Headache Medicine rotation for the neurology residency. Dr Blake is the Director of the Headache Center of River Oaks, Houston, Texas.

Carlton Perry, M.D. completed residency in General Surgery at St. Joseph's Medical Center Hospital, Houston, TX and completed fellowship training in Plastic Surgery at University of Oklahoma Health Science Center in Oklahoma City, OK. Dr Perry is board certified by the American Board of Surgery and the American Board of Plastic Surgery. He is an active member of the International Headache Society, American Headache Society, and Southern Headache Society. Dr Perry is the medical director of the River Oaks Plastic Surgery Center, Houston, Texas.

Collaborators

- Rami Burstein, PhD
- Lynne Davis, PhD, and Robert Cuyler, PhD
- Dionysia Swett, PA-C and Jill Flury, PA-C
- Lynn Nguyen, MA, BS, OTR

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Personal Response

What is next for your research?

"Dr Perry and I continue to work together closely to further awareness of nerve compression as a cause of chronic head and neck pain. We suspect that this condition is much more prevalent among chronic headache sufferers than originally thought. We have learned that early diagnosis and treatment are key to stopping the progression of pain and the development of hormonal and psychological conditions that can accompany chronic pain. We will also continue to work with basic science researchers to study the inflammatory tissue, which appears to play a critical factor in the formation of chronic pain."

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