Neuroplastic Pain in Athletes

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Financial Disclosures

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Learning Objectives

- Explain normal brain function and neural circuits
- Define neuroplastic pain and explain the underlying mechanisms
- Identify the presentation and diagnostic criteria of neuroplastic pain
- Introduce the concept of neuroplastic pain to patients
- Understand the evidence-based treatment options

Normal Brain Function

- The brain creates our reality
  - The Dress
  - Yanni vs. Laurel

Predictive Processing

- Reading
  - Y0UR M1ND 15 R34D1NG 7H15 4U70M471C4LLY W17H0U7 3V3N 7H1NK1NG 4B0U7 17.
- Conversations
- Driving
- Prediction errors
  - An apple a day

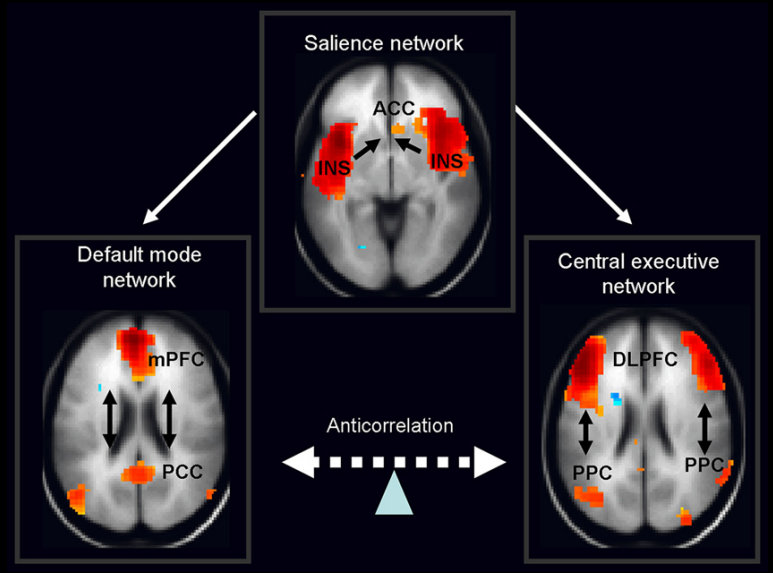
Walsh KS, McGovern DP, Clark A, O'Connell RG. Evaluating the neurophysiological evidence for predictive processing as a model of perception. Ann N Y Acad Sci. 2020 Mar;1464(1):242-268. doi: 10.1111/nyas.14321. Epub 2020 Mar 8.

Neural Circuits

- Learning
- Unlearning
- Backwards brain bicycle: https://www.youtube.com/watch?v=fx1V5KT1Lwo

Pain is a Sensation

- All pain is real
- All pain is created in the brain
- Pain has a purpose
- Salience network



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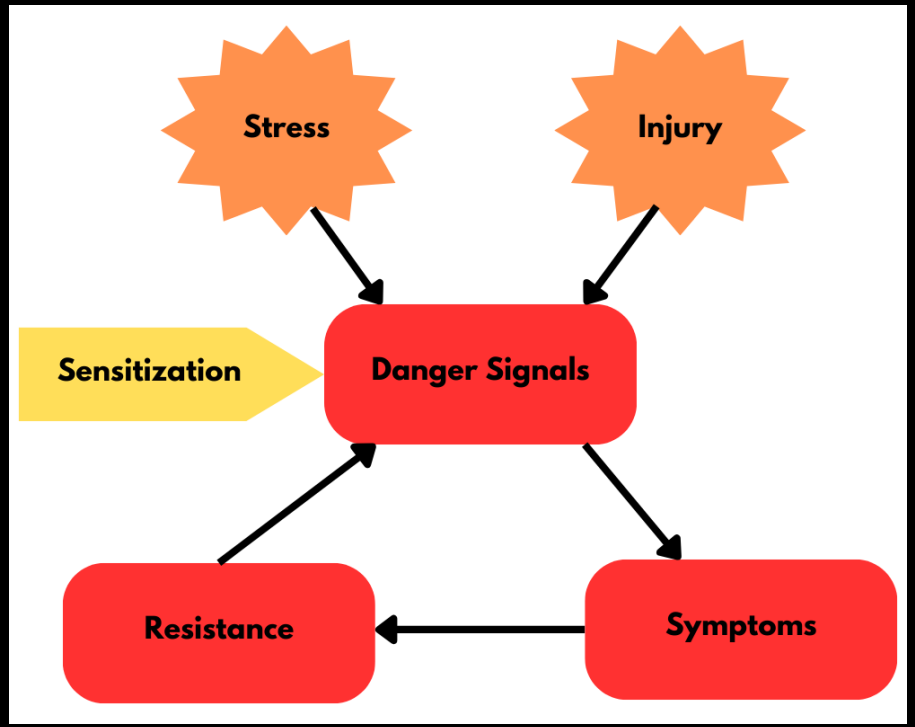
2. Goulden N, Khusnulina A, Davis NJ, Bracewell RM, Bokde AL, McNulty JP, Mullins PG. The salience network is responsible for switching between the default mode network and the central executive network: replication from DCM. Neuroimage. 2014 Oct 1;99:180-90. doi: 10.1016/j.neuroimage.2014.05.052. Epub 2014 May 24.

3 Pain Stories

Fisher, et. al. British Medical Journal, January 7, 1995

Pain Circuitry

Trauma
Repeated microtraumas
ACEs
Chronic stress

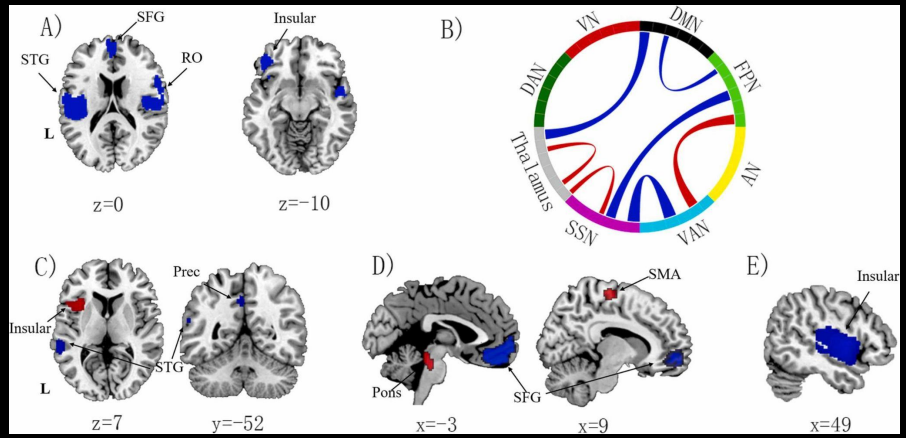


Fear
Frustration
Fixing
Focusing
Fighting
Figuring it out

Headache
Diarrhea
Back pain
Dizziness
Chest pain
Fatigue

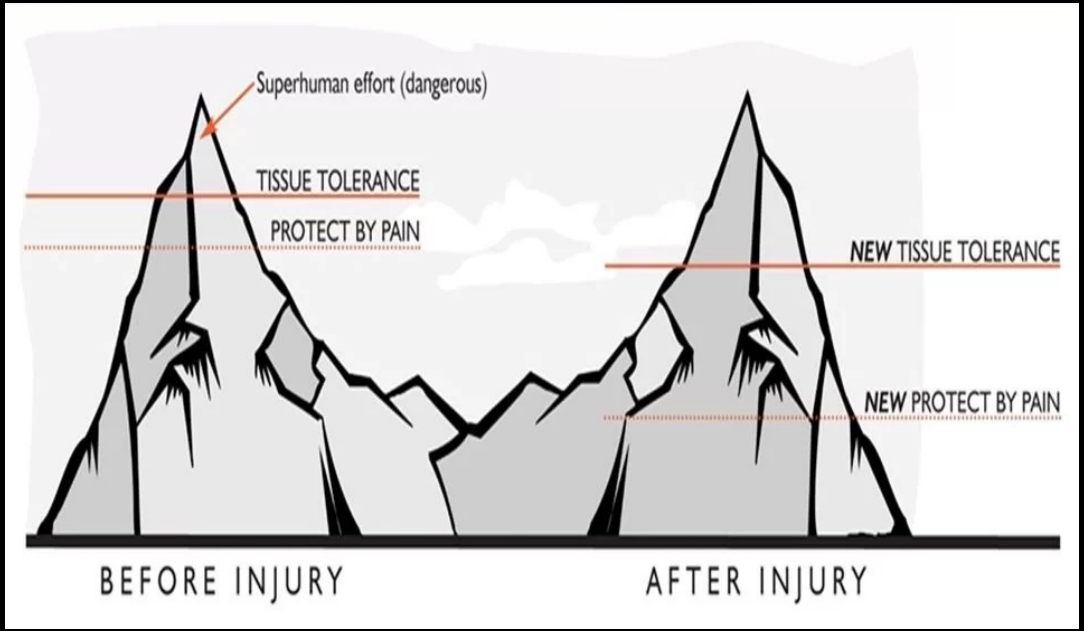
Neuroplastic Pain

- Structural remodeling
- Reorganization of synapses, cells and circuits
- Maladaptive plasticity and altered connectivity
- Central sensitization



1. Kuner R, Flor H. Structural plasticity and reorganisation in chronic pain. Nat Rev Neurosci. 2016 Dec 15;18(1):20-30. doi: 10.1038/nrn.2016.162. Erratum in: Nat Rev Neurosci. 2017 Feb;18(2):158. doi: 10.1038/nrn.2016.158. Erratum in: Nat Rev Neurosci. 2017 Jan 20;18(2):113.
2. Chronic pain-induced functional and structural alterations in the brain: A multi-modal meta-analysis Zeng, Xinglin et al. The Journal of Pain, Volume 28, 104740

Twin Peaks Model



Butler, D. S., & Moseley, G. L. (2003). Explain pain. Noigroup Publications.

Risk Factors for Persistent Pain after Injury

- High intensity of initial pain
- Pain catastrophizing
- Fear-avoidance beliefs
- Depression
- Presence of comorbidities
- Post-traumatic stress symptoms

Alkassabi O, Voogt L, Andrews P, Alhowimel A, Nijs J, Alsobayel H. Risk Factors to Persistent Pain Following Musculoskeletal Injuries: A Systematic Literature Review. Int J Environ Res Public Health. 2022 Jul 29;19(15):9318.

Risk Factors for Neuroplastic Pain

- History of trauma or repeated micro-traumas
- Chronic stress
- Personality traits
- Increased ACEs score
- Pain catastrophizing
- Fear-avoidance beliefs
- Anxiety, depression, OCD/OCP
- History of other neuroplastic symptoms

Terminology Over the Years

- Neuroplastic symptoms
- Neuroplastic pain syndrome
- Neural circuit disorder
- Psychophysiologic pain disorder (PPD)
- Mind-body syndrome (MBS)
- Tension myositis syndrome (TMS)
- Central pain or Primary pain syndrome
- Psychosomatic or psychogenic pain

Neuroplastic Pain Spectrum

Neuroplastic Diagnoses

- Fibromyalgia
- Complex Regional Pain Syndrome I
- Irritable Bowel Syndrome
- Interstitial cystitis
- Non-ulcerative dyspepsia
- Migraine and tension headaches
- Chronic low back pain
- Chronic fatigue syndrome
- Long COVID
- Functional Neurologic Disorder

Other diagnoses:

- EDS
- POTS
- MCAS
- Lyme disease
- Chronic mold toxicity
- Tethered cord syndrome

MSK Neuroplastic Diagnoses

- DDD
- Disc bulge
- DJD
- Sciatica

Prevalence of degenerative spine imaging findings in asymptomatic patients, n=3300

Imaging Finding	Age (yr) 20	30	40	50	60	70	80
Disk degeneration	37%	52%	68%	80%	88%	93%	96%
Disk bulge	30%	40%	50%	60%	69%	77%	84%
Disk protrusion	29%	31%	33%	36%	38%	40%	43%
Annular fissure	19%	20%	22%	23%	25%	27%	29%
Facet degeneration	4%	9%	18%	32%	50%	69%	83%
Spondylolisthesis	3%	5%	8%	14%	23%	35%	50%

Brinjiki W, et. al. Am J Neuroradiol. 2015, 36:811-6.

Natural History of Neuroplastic Pain

- It tends to get worse over time
- It tends to spread
- It tends to shift and vary in location and intensity

Diagnosis

1. Thorough history and physical exam
2. Assess to confirm there is not a biomedical (tissue damage, inflammatory, metabolic, infectious, cancerous, osteopathic) etiology
3. Further questioning about stress, stressful events, thoughts about symptoms, personality traits, and ACEs
4. FIT Criteria
5. Provocative testing

FIT Criteria

- Functional
- Inconsistent
- Triggered

Functional Criteria

- Symptoms begin without a physical precipitation (often occurring with no injury, upon waking up in the morning, or during a time of stress)
- Symptoms persist after an injury has healed (all injuries heal and scars do not cause pain)
- Symptoms are in a distribution pattern that is symmetric in the body, mirror image on the left and right side (this rarely occurs with structural pain)
- Symptoms occur on one whole side of the body or occur on half of the face, head, or torso (this does not fit into a pattern that corresponds to physical damage)
- Symptoms spread over time to different areas of the body

Functional Criteria

- Symptoms radiate to the opposite side of the body or down a whole leg or arm (unlike a nerve pain that would only affect the part of the arm or leg where that nerve is located)

- Symptoms that occur in many different body parts at the same time

- Symptoms that have the quality of tingling, electric, burning, numb, hot or cold (these are commonly MBS, especially when there is no evidence for actual nerve damage)

- Symptoms occur from a prior injury that has healed

Inconsistent Criteria

- Symptoms shift from one location in the body to another, either within hours, days or weeks at a time

- Symptoms are more or less intense depending on the time of day, or occur first thing in the morning or in the middle of the night (this is due to subconscious brain activity)

- Symptoms occur after, but not during, activity or exercise (a structural injury hurts when used and is better when rested)

- Symptoms occur when one thinks about them or when someone asks about it

Inconsistent Criteria

- Symptoms occur when stress is increased or one thinks about stressful situations
- Symptoms are minimal or non-existent when engaged in joyful or distracting activities, such as when on vacation or when not thinking about the symptoms
- Symptoms are minimal or non-existent after some kind of therapy, such as massage, chiropractic, Reiki, acupuncture, an herbal or vitamin supplement (anything that calms the danger signal will tend to decrease symptoms)

Triggered Criteria

- Symptoms are triggered by things that are not related to the actual symptom, such as foods, smells, sounds, light, computer screens, menses, changes in the weather (weather has been shown in research to not increase pain, despite what most people think) or specific movements

- Symptoms are triggered by the anticipation of stress, such as prior to school, work, a doctor’s visit, a medical test, a visit to a relative, or a social gathering; or during those activities

Triggered Criteria

- Symptoms that are triggered by simply imagining engaging in the triggering activity, such as bending over, turning the neck, sitting or standing (this is a great exercise to diagnose MBS as it confirms that the brain is creating pain in the absence of actually performing the activity)

- Symptoms are triggered by light touch or innocuous stimuli, such as the wind or cold (people with MBS are often overall sensitive to touch and light touch doesn't actually affect the deeper body part where the pain is being felt)

Provocative Testing

- Light palpation
- Floating palpation
- Firm pressure palpation

Case Discussions

Case: 16yo Female Dancer

- CC: left ankle pain for almost 2 years
- HPI: Initial injury – inversion ankle sprain, complete tear of ATFL. Treated with prolotherapy. Subsequently developed entire left leg pain, muscle fatigue, numbness and tingling x 1 month. Leg symptoms resolved, but low level ankle pain continued.
- 1.5 years later, sustained left distal fibula avulsion fracture. Treated with walking boot x 4 weeks. Subsequently developed constant entire left leg pain, sometimes numb. Pain was deep, achy, sometimes sharp and would jump around between hip, knee and ankle. Pain worse with any weight bearing or movement, but also at rest.
- Recent repeat XR and MRI showing a healed fracture and ATFL.
- Prior treatment: rest, NSAIDs, PT, prolotherapy, OMT, counseling therapy, dry needling
- Newer onset low back/left lateral hip pain x 4 months

36yo Female Dance Instructor

- CC: worsening HA, brain fog, fatigue, insomnia, dizziness, light/sound sensitivity, scalp burning, neck pain (pre-existing, but worsened), cognitive deficits (math, aphasia), anxiety, depression x 3 months.
- HPI: slip and fall while hiking, hit head on ground. No LOC. Initial symptoms– head pain, disoriented, feeling of being not right.
- ED → probably a concussion
- 1 month post-injury PM&R visit → CT head neg. Prescribed opiate.
- Neuropsych testing → dx postconcussion syndrome
- Neuro → started amitriptyline. MRI c-spine → DDD. Referred for neck PT.
- Neuro-optometry → abnormal exam. Referred for oculomotor therapy.
- ENT → CT and MRI. Referred for vestibular rehab.
- Other treatments: massage, acupuncture, chiro, craniosacral therapy

Case: 60yo Male Musician & Recreational Golfer

- CC: left sided chest wall, “rib” pain x 6 weeks.
- HPI: Pain started after hitting some balls at the driving range. No specific injury and no pain while swinging.
- Went to urgent care. Xray: neg. Diagnosed with “sprained rib”.
- Pain continued and 2 weeks later had a panic attack/out-of-body experience. Very worried about the pain not resolving and something bad going on.
- Prior treatment: rest, heat, ice

Introducing Patients to Neuroplastic Pain

- Listen more than explain
- Ask more questions
- Empathy, compassion, validation
- Provide pain neuroscience education
- Use the examples from this lecture
- Practice neuroscience talk on family, friends, and coworkers
- Let them find evidence
- Start by starting

Evidence-based Treatment

- Neuroplastic Recovery Therapies
  - Pain Reprocessing Therapy (PRT)
    - Pain neuroscience education
    - Somatic tracking
    - Graded exposure
  - Emotional Awareness and Expression Therapy (EAET)
- Trauma-informed care
- Internal Family Systems (IFS) Therapy
- Cognitive Behavioral Therapy (CBT), Acceptance Commitment Therapy (ACT)
- Hypnotherapy
- Neurofeedback

Osteopathic Considerations

- Each person is a unit of body, mind and spirit
- The body is capable of self-regulation, self-healing and health maintenance
- OMT → autonomic nervous system activity

Cerritelli F, Cardone D, Pirino A, Merla A, Scoppa F. Does Osteopathic Manipulative Treatment Induce Autonomic Changes in Healthy Participants? A Thermal Imaging Study. Front Neurosci. 2020 Aug 18;14:887. doi: 10.3389/fnins.2020.00887. PMID: 33013294; PMCID: PMC7461826.

Ruffini N, D'Alessandro G, Mariani N, Pollastrelli A, Cardinali L, Cerritelli F. Variations of high frequency parameter of heart rate variability following osteopathic manipulative treatment in healthy subjects compared to control group and sham therapy: randomized controlled trial. Front Neurosci. 2015 Aug 4;9:272. doi: 10.3389/fnins.2015.00272. PMID: 26300719; PMCID: PMC4523739.

Plan

- Validate their pain is real
- Start the neuroscience education
- Refer to PRT/EAET-trained, trauma-informed practitioner
    - DO, MD
    - PT, OT, SLP, AuD
    - PhD, PsyD, LMSW, LCSW
    - Coach
    - https://www.symptomatic.me/practitioner-directory#!directory/map/ord=rnd
    - Curable app

Key Takeaways

- Sometimes pain is nociceptive from tissue damage.
- Sometimes an injury heals, yet the brain perpetuates the pain.
- Sometimes there never was tissue damage to the body, and the brain has created the pain without a nociceptive signal.

Key Takeaways

- This isn’t a conscious process. The person is not choosing to have these symptoms, which means they cannot simply choose to not have these symptoms. This isn’t a mind over matter situation.
- Even though this process lives in the unconscious brain, because it is neuroplastic, we can still use the conscious brain to unlearn it.
- This is highly treatable when correctly identified

Additional Resources

Freedom From Chronic Pain - https://freedomfromchronicpain.com

Association for the Treatment of Neuroplastic Symptoms - https://www.symptomatic.me/

“Unlearn Your Pain” by Howard Schubiner, MD

“The Way Out” by Alan Gordon, LCSW

Physician Empathy and Chronic Pain Outcomes. John C. Licciardone, DO, MS, MBA, 1 Yen Tran, BS, 2 Khang Ngo, BSA, 2 David Toledo, BA, 2 Navya Peddireddy, BS, 2 and Subhash Aryal, PhD 3. JAMA Netw Open. 2024 Apr; 7(4): e246026. Published online 2024 Apr 11. doi: 10.1001/jamanetworkopen.2024.6026

The Therapeutic Alliance Between Clinicians and Patients Predicts Outcome in Chronic Low Back Pain. Paulo H. Ferreira, Manuela L. Ferreira, Christopher G. Maher, Kathryn M. Refshauge, Jane Latimer, Roger D. Adams Author Notes. Physical Therapy, Volume 93, Issue 4, 1 April 2013, Pages 470–478, https://doi.org/10.2522/ptj.20120137

Resources

Emotional awareness and expression therapy, cognitive-behavioral therapy, and education for fibromyalgia: a cluster-randomized controlled trial. Mark A Lumley, Howard Schubiner, Nancy A Lockhart, Kelley M Kidwell, Steven E Harte, Daniel J Clauw, David A Williams. Pain. 2017 Dec;158(12):2354–2363

Emotional Awareness and Expression Therapy vs Cognitive Behavioral Therapy for Chronic Pain in Older Veterans: A Randomized Clinical Trial. Brandon C. Yarns, MD, MS; Nicholas J. Jackson, PhD, MPH; Alexander Alas, AA; et al, Rebecca J. Melrose, PhD; Mark A. Lumley, PhD; David L. Sultzer, MD. JAMA Netw Open. 2024;7(6):e2415842

Ashar YK, Gordon A, Schubiner H, Uipi C, Knight K, Anderson Z, Carlisle J, Polisky L, Geuter S, Flood TF, Kragel PA, Dimidjian S, Lumley MA, Wager TD. Effect of Pain Reprocessing Therapy vs Placebo and Usual Care for Patients With Chronic Back Pain: A Randomized Clinical Trial. JAMA Psychiatry. 2022 Jan 1;79(1):13-23. doi: 10.1001/jamapsychiatry.2021.2669. PMID: 34586357; PMCID: PMC8482298.

Thank You!

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