# REHAB TECHNIQUES IN PAIN AND NERVE COMPRESSION SYNDROMES

*– Written by Alison Taylor, USA*

## INTRODUCTION

As therapists, we have an extensive list of protocols to return our athletes to play, but the biggest determining factor to get them back on the field or court is pain. Even if all the tests indicate that they are ready, they won't be able to play if they report pain when executing certain movements required in their sport.

Diane Jacobs states that "pain is a peripheral nervous system problem."[1] Therefore, we need to focus on the neural system, not just the motor system, but the sensory system as well, since all pain or perception of pain originates from the receptors in the neural system. Unfortunately, this system is underrepresented in the therapy process, yet it holds the key to eliminating the last 10-20% of pain and restoring muscle strength.

The body has several layers, each with receptors that read information and communicate it to the brain. The sensory receptors gather information, while the motor receptors respond to it. The sensory receptors and the motor receptors affect each other, and if there is a delay or a crash in the sensory line, there will be a subsequent delay in the motor system response. This delay can lead to a system-wide change that lasts longer, the longer it takes to fix the problem.

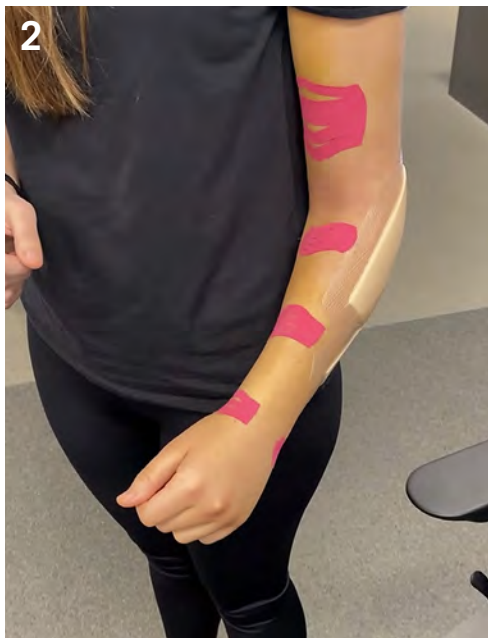
Therefore, if a nerve pathway is impeded in any way, superficially and/or deeply, the chance of recovery or re-injury is greater since the response time is impaired. This is especially relevant to the peripheral or distal parts of the body, such as the wrist/hand or foot/ankle. If we ignore these body parts, which are the end of the train lines and highly influential on the system as a whole, we will miss the bigger picture.

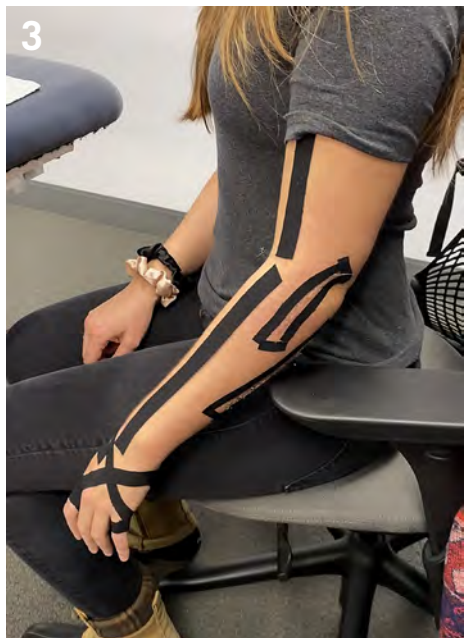
For instance, a soccer player has fast-adapting receptors in the ankle joint that detect joint position sense. These receptors activate quickly to provide ankle stability so the player can kick the goal. However, if there is any delay in the communication channel, either up or down, the player will be at greater risk of sprains, strains, fractures, or even ligament tears. These receptors can also cross other lines, so an injury in the elbow could also impact another body part over time. This concept is called biotensegrity, as described by Steven Levin.

## SUPERFICIAL NERVE COMPRESSIONS

Most of the time we are looking for the answers to pain in the muscles and joints, but what if we looked closer at the superficial layers?

We have 6 physiological layers: skin, fascia, circulatory lymphatic, muscle, tendon, and ligament. All layers are heavily embedded with sensory receptors that gather information and report it to the brain at lightning speed. If the brain likes what it "feels" the response will be to allow motion, relax a muscle, and stabilize a joint. But if doesn't like what it feels, it reacts by turning on a cascade of protective barriers in every physiological layer. These

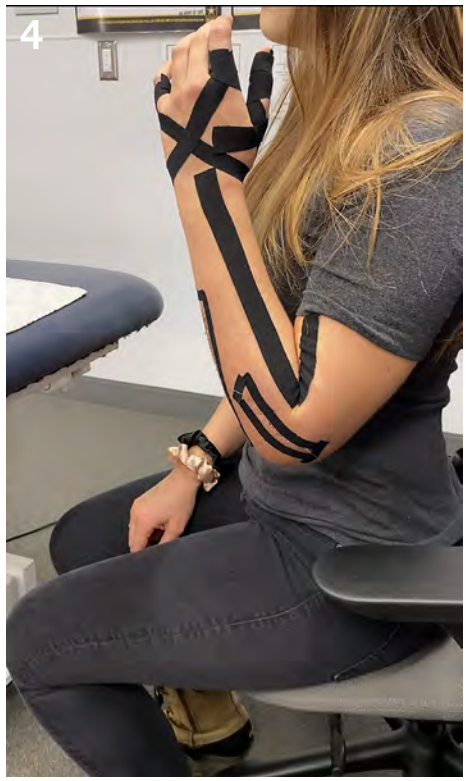




**Figure 1:** Elbow flexion post hardware removal – terrible triad.

**Figure 2:** Elbow extension post hardware removal.

**Figure 3:** Elbow extension:10 days later only focusing on skin and fascia layers.

**Figure 4:** Elbow Flexion: 10 days later- no pain in either position.

include tightness (skin and fascia), swelling (circulatory lymphatic), weakness (muscle), and stiffness (joint). These are all things the athlete will tell us are limiting them to return to play.

The skin is the largest sensory organ in the body and has the highest number of pain receptors. If we have determined that pain is a limiting factor in returning to sport, and since most of the pain receptors are found in the skin, then shouldn't skin be part of our focus in treating pain in athletes? Current treatments that address this physiological layer include cupping, soft tissue massage (STM), instrument-assisted soft tissue massage (IASTM), acupuncture, and electrical modalities like transcutaneous electrical nerve stimulation (TENS). It may be, however, that we are not thinking of the skin layer while we are doing these modalities.

Every time we are stretching a patient, doing joint mobilization, or strengthening, we are impacting the skin. The skin is gliding in some direction and must have the ability to move freely and independently from the muscle, joint, and fascia. The problem arises when the skin cannot glide freely and becomes adherent to the structures below. When this occurs, it can activate pain receptors with every movement of a joint or a contraction of a muscle, as it also activates receptors in all those other physiological layers.

If you add arthroscopic scars around a knee or shoulder this tension will not just penetrate to the joint layer, but to all physiological layers. Therefore, treating the scar should be the first thing to do to stop pain-protective responses from occurring at all. Taping around a scar with elastic therapeutic tape (ETT) immediately post-surgery with 10% tension will keep the skin mobile, reduce swelling, and keep the pain receptors from chronically activating (Figures 1-4). A study by Klein et al[2] assessed taping with sterile Kinesiotape on sternotomy patients and reported a significant reduction in pain, respiration, and narcotic use.

*Remember - we have the power to manipulate the information that the brain is receiving.*

We think we are doing a lot of things, but as therapists, all we are doing is touching the skin. But we have power in our hands if we learn how to touch the skin effectively. All we must do is override the pain receptors. If you can do this, you will quickly and easily reduce swelling, increase muscle function, and eliminate pain in 1-2 therapy sessions. If we study the dermal layer receptors and target the right ones, we can change the information the brain receives and therefore how it responds. The key is being light in our treatment approach. The more aggressive the treatment, the more protective the body will be. I know this concept, but this is hard to imagine because we have been trained in the "no pain no gain" treatment model for years and years. But just because we have always done something a certain way, does it mean we should keep doing it a certain way?

SKIN THERAPY MODALITIES

Vibration is the best-kept secret and has been right in front of us since the 1950s when Melzack and Wall described the "gate-control theory"[3].Essentially it means that the receptors that perceive pain and temperature travel to the brain along one pathway and all the other receptors (light touch, vibration, deep pressure, and proprioception) travel on another pathway. So, our goal should be to override the pain receptors by stimulating the other pathways. A fun fact is that the light touch and vibration receptors are faster than pain receptors, and therefore get to the brain quicker. So, if we stimulate those receptors during therapy or at home, the brain doesn't perceive the pain and therefore doesn't need to protect the area of injury.

One answer to overriding pain is to use very light vibration - under 130 Hz. This will target the dermal layer receptors- especially the Meissner Corpuscles (light touch and vibration) and Pacinian Corpuscles (vibration and deep pressure). Vibration placed above the site of pain with gentle vibration balls for the first 1-2 weeks post-injury or surgery, will create an enormous change in outcomes. By adding ETT to lift and create movement in the tissue on or around the area of pain, you can additionally stimulate the light touch and Ruffini receptors (skin stretch receptors) which are slow-adapting receptors. What this means is that the body will concentrate on the superficial stimulation and not detect the deeper pain for extended periods.

Another option is to use a TENS machine which also stimulates the superficial layer and can override pain. The longer the brain does not detect pain, the faster the outcomes. Pain may be used as a guide to limit therapy but not a part of the actual therapy since it will slow up the healing process.

*How else can we reduce pain?*

The tighter the skin and more adherent it is to other layers the more the pain receptors will fire. Long-term immobilization, swelling, scars, or sustained pressure from braces or casts will all keep the pain cycle going. The quicker we relieve the pressure on the skin and fascia layers the quicker the rehab process. Unfortunately, we may have to immobilize the limb, but we don't need to immobilize the skin. Ask the patient to massage or use light vibration above the site of pain and isometrically contract all muscles in the splint or brace every hour, if approved by the surgeon.


If we trust our athletes to remove the brace while the leg or arm is supported, they should work on the tissue where the straps have been. These tight straps create chronic compressions on the whole neural system, at multiple sites, on multiple nerve pathways, both superficial and deep.

SCAR MANAGEMENT

Scars can have the biggest impact on movement dysfunction and create a delay in the somatosensory system of the body. A dense adherent scar can pull the skin, and underlying superficial nerves, tightly toward the scar, creating dysfunction in the speed and processing of the sensory nerves. An arthroscopic or pin site scar, although small, is the most influential as it involves all physiological layers, activating not just joint receptors but also the soft tissues above it. Hagert[4,5] described the impact of skin receptors being influential in conditions in the hand and fingers since the speed or reception will be detected faster by the skin receptors than the muscle spindles which are further away. This impact applies to any muscle whose insertion is very distal from the origin, i.e., finger extensor and flexor muscles.

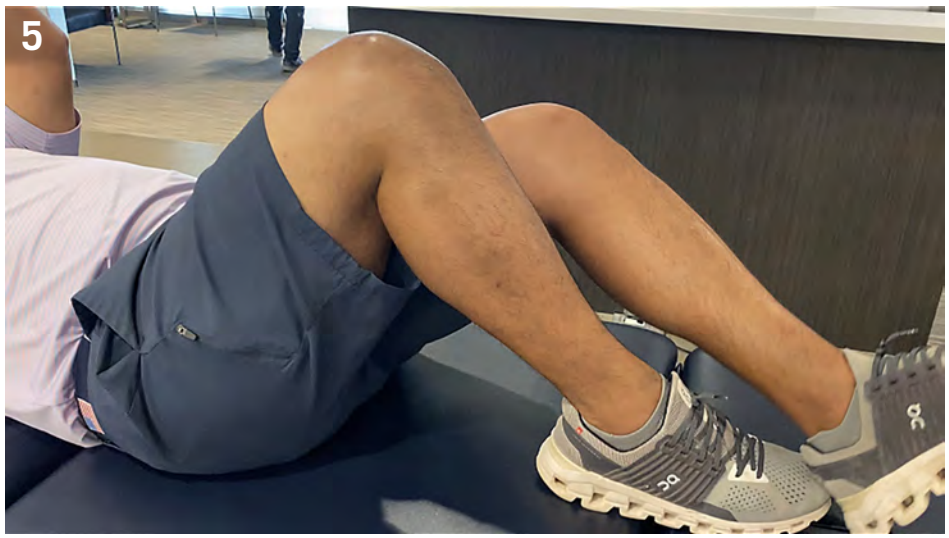
If the detection system is impaired by a scar that tensions the skin, then the

response system is also impaired. It can be delayed, insufficient, or even incorrect.

Any pause or impairment in the body's response, for instance, while catching a ball in cricket or planting your foot in soccer, can result in additional injury.

If a long period of immobilization is required, like with an Achilles tendon (up to 8-10 weeks), and no one is addressing the scar in this time frame, we are wasting precious time to restore function. The ankle is richly innervated in the anterior joint and collateral ligaments, but the pull of the skin after an Achilles tendon repair is towards the posterior ankle and calf scars. This pull will traction the skin receptors as well as impair the deeper joint receptors. Another fun fact - joint receptors include Pacinian corpuscles and Ruffini receptors- the same ones that like vibration and ETT. So, taping the ankle joints and adding vibration during immobilization can have a huge impact on recovery.

Arthroscopic scars at the wrist in golfers, rotator-cuff scars in overhead athletes, and ACL scars in football, rugby, or soccer, all create tension across joint lines. These tensions increase through flexion of the joint and the skin will essentially end up acting like a tourniquet. Once these skin lines tighten to the point of activation of sensory receptors, the body will shut down motion, no longer allow muscle contraction, or stiffen the joint. But think deeper now. The arthroscopic scars are going into the joint- so deeper receptors will also be involved in blocking normal neuromuscular and proprioceptive functions.



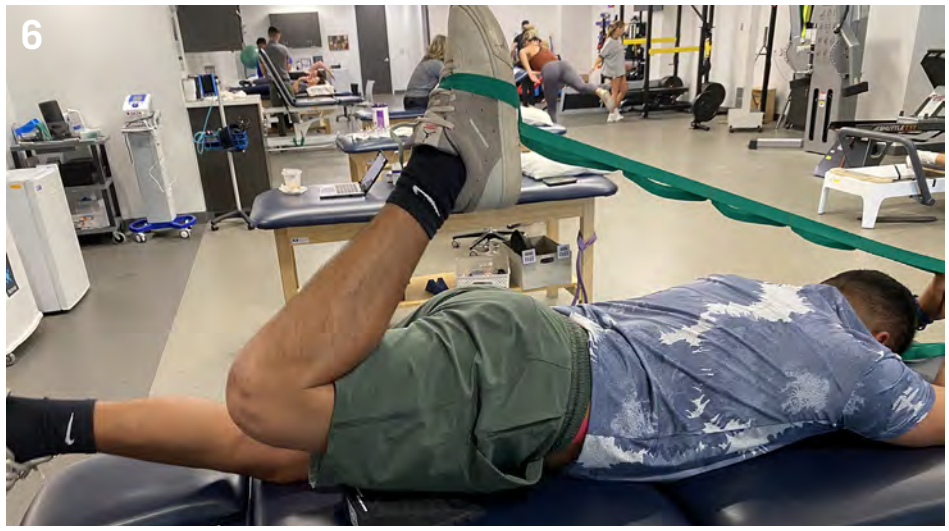




**Figure 5:** Knee Flexion: Several months after knee surgery.

**Figure 6:** Knee Flexion:- 8 Visits- Treatment focuses on skin and fascia layer only- no pain with any ROM.

SCAR THEORY IN PRACTICE (Figures 5 and 6)
A very simple technique to test this Golgi Tendon Organ (deeper receptors) scar theory is this:

When you do PROM (passive range of motion) on a shoulder after arthroscopic surgery, there will be a point where you feel a little flicker, then the patient will almost immediately have a protective stop in motion. Pain will immediately increase, especially if you continue to try to range the shoulder. When you come out of the motion ask the patient where the pain is, and they will likely point to one of the scars. Glide the scar, with your finger in different directions like a clock (Manual Direction Test, as described by Kenzo Kase)[6] while you do ROM again and see how movement improves. Once you find the right direction, tape the skin in that direction, and the ROM will be smoother, and you will gain approx. 10-20 deg more motion without pain.

As the joint then goes higher, you will see another flicker, and the motion will stop again. Bring the arm back down and I guarantee they will point to the next scar. Perform the same technique again. Using this approach, you can have full PROM with no pain in 2 weeks with any arthroscopic shoulder surgery.

Traditional methods of elevation, ice, muscle pumping, and compression while all effective can be enhanced if we work closer with the top layer of the body. All patients should be encouraged to massage and move the skin multiple times a day. Even be allowed to remove the brace or splint (with strict parameters) and not allow the skin to become adherent. Immobilization of a joint may be necessary post-injury, but immobilization of the skin should not. This requires excellent communication between the surgeon and therapist, with a high level of trust. Even if the patient is casted, splinted, or wearing a brace it is important to keep the skin moving by regular small contractions of all tissue layers.

Stiffness, pain, and swelling lead to more stiffness, pain, and swelling. You don't have to work to get rid of swelling you just have to change the information to the brain. Decrease the pressure on the dermal layer by creating lift and movement- not compression, and you will see the swelling magically disappear. People who have the tightest skin post-injury or surgery usually have the most pain.

> ***Pain is a peripheral nervous system problem. Therefore, we need to focus on both motor and sensory symptoms when treating athletes in pain.***

DEEP NERVE COMPRESSIONS

Visualize the neural system as a long strand of Christmas tree lights, with small branches off to innervate individual muscles, joints, and connective tissue. These are the motor nerves. The motor nerves course deep within the body and wrap around bones, between muscles, under ligaments, and must glide and slide freely along their course. If the nerve is unable to freely move, then its ability to activate muscles, ligaments, and protective fascia will be diminished. This will also result in pain, weakness, instability, and possible paresis. Over time this can be career-changing as the nerve conduction ability is permanently compromised and the athlete will not regain the strength or stability to return to play.

Fortunately, most nerve impairments can be quickly assessed and often addressed with surgery. Surgical intervention can release compression on nerves and restore the function and pathways without impedance. The minimally invasive surgery performed under WALANT (wide-awake local anesthesia no tourniquet) will demonstrate immediate restoration of motor function and performance while the patient is wide awake and confirms the impact of nerve compression on motor weakness.

Common surgeries in the upper extremity including carpal tunnel release (median nerve), cubital tunnel release (ulnar nerve), and Guyon's canal (ulnar nerve) all respond well to therapy, and the general goal in rehabilitation is scar management, ROM, nerve glides, and strengthening.

It is important to remember, however, that the neural tension created on these nerve pathways doesn't just magically occur. It is a slow process of muscle imbalances over time that create joint faults as described by Brian Mulligan, and Mobilization and movement (MWM)[7]. These faults can result in traction of nerves anywhere along the pathway[8], and it is often around large "corners" like the medial elbow (ulnar nerve), ulna styloid (ulnar nerve), or base of the thumb (sensory branch of the radial nerve). Additionally, compressions can occur through muscles or ligaments: e.g., Radial Tunnel (posterior interosseous nerve), Quadrangular space (axillary nerve), or Lacertus Syndrome (median nerve).

What is often not considered after surgical release is what biomechanical fault created the tension on the nerve to begin with. If not addressed properly, the athlete may return at some point with neural traction in another location on the same nerve pathway or a neighboring nerve. Consider the ulnar nerve release at the cubital tunnel and the incidence of additional surgery or transpositions[9]. Are recurrence and revision surgeries because the joint alignment and muscle imbalances were not addressed effectively in rehab? Each surgery should have a very specific therapy program that targets the joint attributed to corresponding nerve traction, but also specific to the sport. The same surgery performed on a tennis player and a golfer should have a different rehab program.

*Ulnar nerve compression and rehab*

Areas that create the most traction on the ulnar nerve are the ulnar wrist, medial elbow, and the anterior armpit. Significant muscle imbalances along this pathway include brachialis, pectoralis major, latissimus dorsi, and teres major, all fascia connections as described by Myers[10], but our rehab is very often not targeting these muscles.

The current protocols are generally targeting external rotators, not internal rotators which will be insufficient with any diagnosis on the medial elbow side of the body.

*Radial nerve compression and rehab*

The same is true for lateral arm injuries and the radial nerve. Any injury or surgery occurring on the lateral arm, i.e., humerus fracture, or lateral epicondylitis, has very different fascia pathways to that of the ulnar nerve, and thus different muscle relationships and rehab need to be considered.

Surgery in the lateral arm and radial nerve should target muscles including, but not limited to, the supinator, deltoid, and upper trapezius.

Recovery positions especially with shoulder or elbow surgery will create shortening in the muscles and joints, but

significant shortening of all the 3 major nerves in the upper extremity, especially the radial and ulnar nerve. If the nerve is shortened, then the protective response will be greater. A way to elevate this is to have the athlete perform hourly wrist and neck exercises, when immobilized, to allow the excursion of all neural pathways.

CONCLUSION

The neural system holds the answers to pain, and we should consider the top 3 physiological layers the skin, fascia, and circulatory lymphatic in our treatments. If we target these areas at the beginning of our rehabilitation programs, we will see our athletes returning to sport faster, without pain, and with less potential for re-injury.

*Alison Taylor OTR/L, CHT, CKTP, CKTI, NDTC*

*Baylor Scott & White Health*

*Sport Therapy and Research at the STAR*

*Senior Certified Hand Therapist for the "STAR" Baylor/Dallas Cowboys*

*Frisco TX, USA*

*Contact: alisontaylorcht@gmail.com*

*References*

1. *Jacobs, D. (2016). Dermo neuro modulating: manual treatment of peripheral nerves and especially cutaneous nerves (1st ed., p. 292). Diane Jacobs.*
2. *Klein HM, Brockmann R, Assmann A. Pain-diminishing effect of Kinesio taping in patients after sternotomy. J Cardiothorac Surg. 2015 Dec 16;10(Suppl 1):A76. doi: 10.1186/1749-8090-10-S1-A76. PMCID: PMC4693911*
3. *Moayedi M, Davis KD. Theories of pain: from specificity to gate control. J Neurophysiol. 2013 Jan;109(1):5-12. doi: 10.1152/jn.00457.2012. Epub 2012 Oct 3. PMID: 23034364.*
4. *Hagert E. Proprioception of the wrist joint: a review of current concepts and possible implications on the rehabilitation of the wrist. J Hand Ther. 2010 Jan-Mar;23(1):2-17. doi: 10.1016/j.jht.2009.09.008. Epub 2009 Dec 5. PMID: 19963343.*
5. *Hagert E, Rein S. Wrist proprioception-An update on scientific insights and clinical implications in rehabilitation of the wrist. J Hand Ther. 2023 Oct 20:S0894-1130(23)00139-4. doi: 10.1016/j.jht.2023.09.010. Epub ahead of print. PMID: 37866985.*
6. *Kase, K. W. (2013). Clinical Therapeutic Applications of the Kinesio Taping Method: 3rd edition (3rd ed., p. 198). Kinesio.*
7. *Baeske R, Hall T, Silva MF. The inclusion of mobilisation with movement to a standard exercise programme for patients with rotator cuff related pain: a randomised, placebo-controlled protocol trial. BMC Musculoskelet Disord. 2020 Nov 12;21(1):744. doi: 10.1186/s12891-020-03765-6. PMID: 33183274; PMCID: PMC7663889.*
8. *Taylor A, Wolff AL. The forgotten radial nerve: A conceptual framework for treatment of lateral elbow pain. J Hand Ther. 2021 Apr-Jun;34(2):323-329. doi: 10.1016/j.jht.2021.05.009. Epub 2021 Jun 27. PMID: 34193382.*
9. *Kong L, Bai J, Yu K, Zhang B, Zhang J, Tian D. Predictors of surgical outcomes after in situ ulnar nerve decompression for cubital tunnel syndrome. Ther Clin Risk Manag. 2018 Jan 4;14:69-74. doi: 10.2147/TCRM.S155284. PMID: 29379297; PMCID: PMC5757488.*
10. *Myers, T. W. (2020). Anatomy Trains (4th ed., p. 378). Elsevier.*