DRY NEEDLING AND HYPERMOBILITY

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While the impact of dry needling (DN) has been established for a wide variety of indications and body regions (Blanco-Díaz et al., 2022; Fernandez-de-Las-Penas, Perez-Bellmunt, et al., 2021; Fernandez-De-Las-Penas, Plaza-Manzano, et al., 2021; Forogh et al., 2023; Giorgi et al., 2022; Griswold et al., 2022; Hadizadeh et al., 2021; M. Hernández-Secorún et al., 2023; Mar Hernández-Secorún et al., 2023; Javier-Ormazábal et al., 2022; Jiménez-Del-Barrio et al., 2022; Navarro-Santana et al., 2021; M.J. Navarro-Santana et al., 2020; M. J. Navarro-Santana et al., 2020; Nuhmani et al., 2023; Pourahmadi et al., 2021; Rodríguez-Huguet et al., 2022; Sarmiento-Hernández et al., 2020; Ughreja & Prem, 2021; Valera-Calero et al., 2022; Vázquez-Justes et al., 2022), it is not necessarily clear when or even whether dry needling of patients with systemic hypermobility is indicated. Hypermobile individuals may "create" muscle contractures, commonly known as "taut bands' in the myofascial pain literature, to provide a degree of stability in otherwise unstable joints. It is conceivable that lowering the muscle tone of such contractures would increase joint instability, leading to an immediate decrease in function. Before deciding to use dry needling on a patient with hypermobile joints, a brief review follows summarizing some of the main characteristics of hypermobility, Ehlers Danlos Syndrome (EDS), and Hypermobility Spectrum Disorders (HSD).

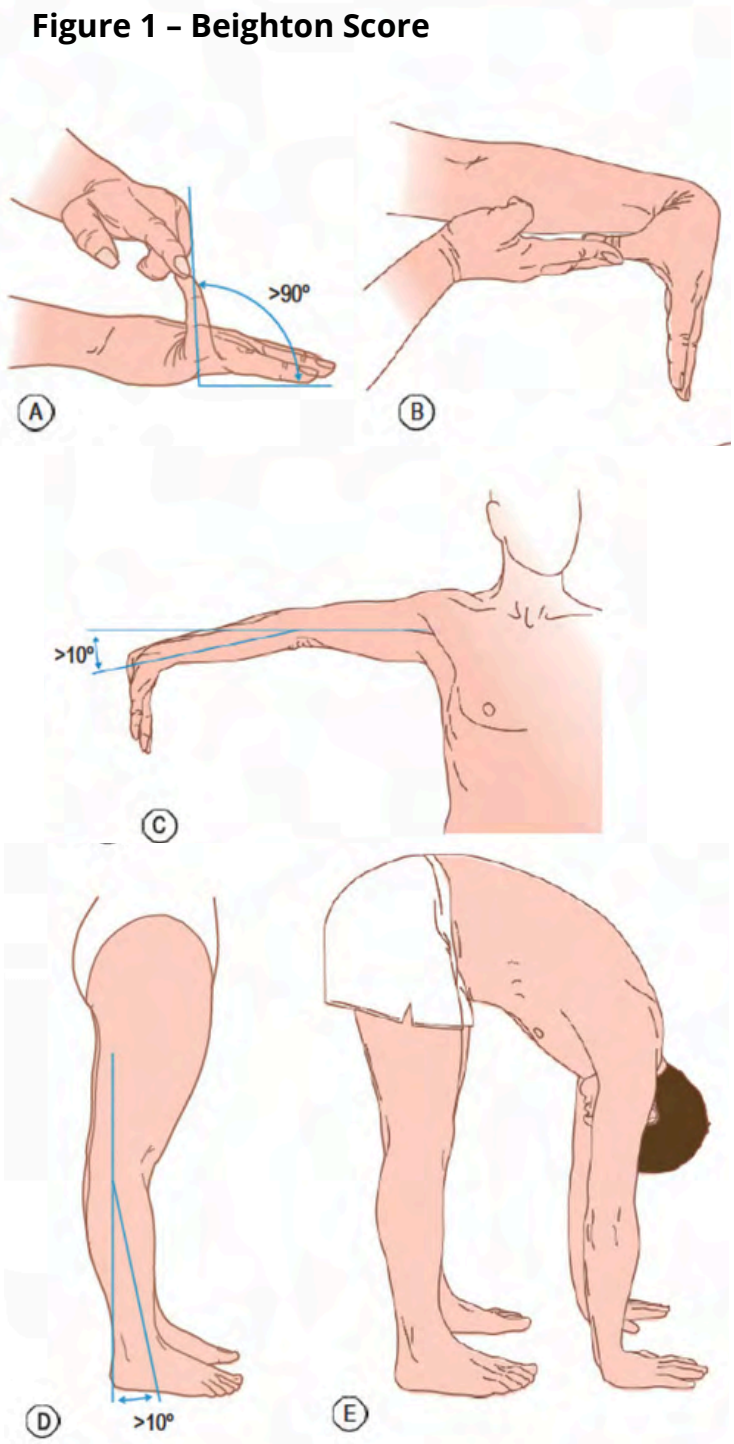
Hypermobility

Joint mobility is a prerequisite to movement and motor development. Physiotherapists and other healthcare providers commonly measure joint range of motion against suggested norms required for movement efficiency (Soucie et al., 2011). When joint range deviates from these normative values, clinicians characterize the joint to be either hypo- or hypermobile, and offer therapy to address impairments in joint mobility and improve movement efficiency (Keer & Simmonds, 2011).

Hypermobility is quite common in patients, ranging from having one or two hypermobile joints to having generalized HSD or EDS (Dommerholt & Mayberry, 2021; Malfait et al., 2017). Hypermobility is defined as excessive joint movement within a normal plane of motion. Although in the clinic the terms hypermobility, hyperlaxity, and hyperextensibility are often used interchangeably, the terms are not equal as the latter refer only to movement in abnormal planes (Coles et al., 2017).

Hypermobility can be structural, constitutional, or hereditary, but it can also result from functional changes in the joint and surrounding tissues. Localized hypermobility may be due to training, excessive stretching, trauma, including surgery, or a joint dislocation, among others, but it can also be hereditary. Generalized or systemic hypermobility involves more than five joints, and usually is hereditary with significant individual differences based on age, sex, and ethnic background (Coles et al., 2017). The most common genetic conditions associated with systemic hypermobility include Ehlers Danlos Syndrome, Marfan Syndrome, and Down Syndrome. Physiotherapists may assess systemic hypermobility with the Beighton Score (Figure 1), which has acceptable interrater reliability but inconclusive validity (Juul-Kristensen et al., 2017). Several other commonly used tests lack satisfactory reliability and validity (Juul-Kristensen et al., 2017). The Five-Part Questionnaire (Table 1) is the most used questionnaire for adults with conflicting evidence of reliability and validity (A. J. Hakim & R. Grahame, 2003; Juul-Kristensen et al., 2017). Another commonly used test is the Bristol Impact of Hypermobility test, which measures the impact of hypermobility on a person's life, showed excellent test-retest reliability (Palmer et al., 2017).

Figure 1 – Beighton Score



The Beighton Tests

A. With the client seated, ask them to place their forearm and hand, pronated on the table. Ask them passively extend the 5th finger. An extension beyond 90 indicates a positive test.

B. With the client seated, arm flexed 90 in shoulder, elbow extended 180 and hand pronated and relaxed, ask them to passively move the first finger to the volar aspect of the forearm. If the forearm is reached the test is positive.

C. With the client standing in front of you, ask them to abduct 90 in the shoulder with relaxed elbow and supinated hand. Support the upper arm with your ipsilateral hand. An extension beyond 10 indicates a positive test.

D. With the client standing in an upright position, turning towards you, ask them to relax and hyperextend their knee. An extension beyond 10 indicates a positive test.

E. From standing position, with their feet slightly apart, ask the client to place their hands on the floor maintaining extended knees. if the palms of the hands can easily be placed on the floor, the test is positive.

Tests A. to D. are doubled-sided giving a total of nine tests.

Table 1. The Five-Point Questionnaire (A. J. Hakim & R. Grahame, 2003)

1. Can you now (or could you ever) place your hands flat on the floor without bending your knees?
2. Can you now (or could you ever(bend your thumb to touch your forearm?
3. As a child, did you amusre your friends by contorting your body into strange shapes or could you do the splits?
4. As a child or teenager, did your shoulder or kneecap dislocate on more than one occasion?
5. Do you consider yourself 'double-jointed'?

A "yes" answer to two or more questions suggests joint hypermobility with 80-85% sensitivity and 80-90& specificity.

Systemic hypermobility usually does not pose any major problems until puberty. In clinical practice, many teenage girls with EDS experience their pain and major dysfunction within weeks or months after their first menses. Changes in hormonal levels in young women can trigger alterations in the extracellular matrix synthesis and sensitize fascial nociceptors (Fede et al., 2019).

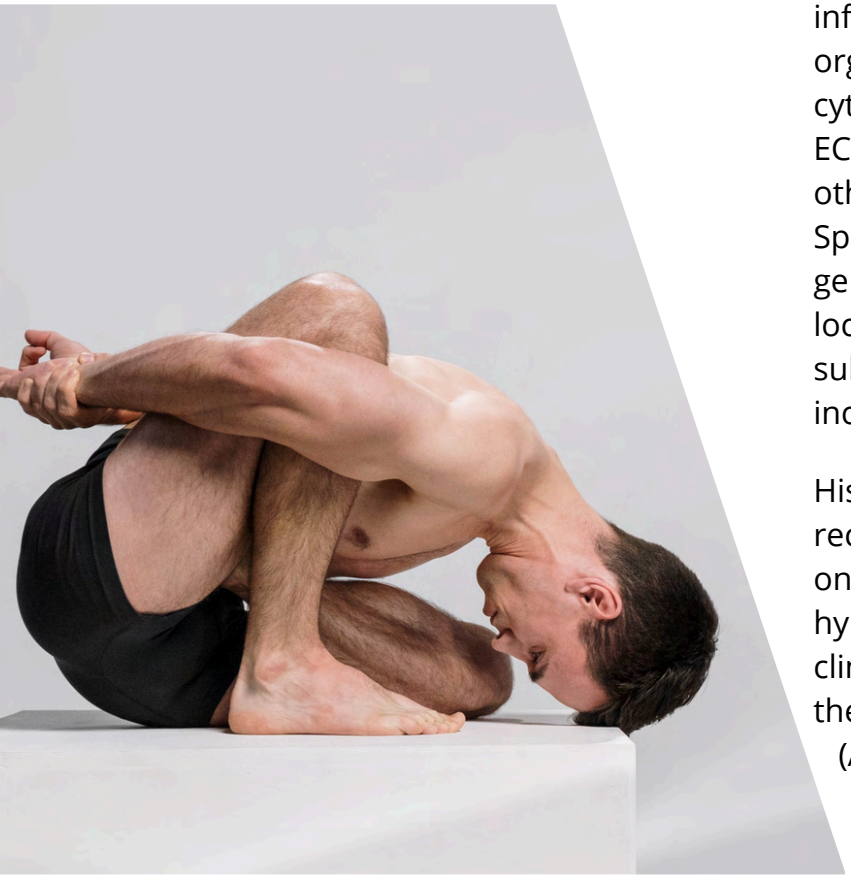
Most children are hypermobile with girls having greater joint mobility than boys. Range of motion tends to increase until adolescence and tapers off into adulthood and old age. Since joint mobility in children is far greater than in adults, diagnosing hypermobility in children is challenging as there are no age-related norms for range of motion in children. An Australian study of 1,584 subjects showed that 61% of girls and 37% of boys were hypermobile (Morris et al., 2017), which does not necessarily indicate that these children had abnormal range of motion or experienced disproportionate pain or dysfunction. Javadi Parvaneh and Shiari (2016) modified the Beighton criteria to improve the identification of hypermobility in children (Javadi Parvaneh & Shiari, 2016), but this test is not commonly used as most children with hypermobility are not symptomatic.

It Is Important to realize that not all hypermobile people are symptomatic

(Juul-Kristensen et al., 2017). However, those with systemic hypermobility tend to have higher reports of pain. A study of 466 subjects with EDS demonstrated that 99% suffered from joint pain, 91% suffered from extremity pain, with many common comorbidities, such as chronic fatigue (82%), anxiety (73%), and depression (69%) (Murray et al., 2013). Joint hypermobility was a common precursor to pain hypersensitivity and central sensitization in 40 hypermobile adolescents (Bettini et al., 2018).

Ehlers Danlos Syndrome and Hypermobility Spectrum Disorders

As summarized in the 2017 EDS clinical classifications, Ehlers-Danlos Syndromes are a heterogeneous group of thirteen different but overlapping connective tissue disorders, featuring joint hypermobility, skin hyperextensibility, and fragile tissues (Table 2) (Malfait et al., 2017). Many patients with EDS experience persistent pain, autonomic dysfunction, and gastrointestinal dysmotility (Beckers et al., 2017). Each subtype has its own specific major and minor criteria. For all subtypes, except the hypermobile subtype, the definitive diagnosis must be made by molecular confirmation with identification of the involved gene(s), which implies that the diagnosis of hypermobile EDS is made based on history, examination and a clinical impression (Malfait et al., 2017).



> **Ehlers-Danlos Syndromes are a heterogeneous group of thirteen different but overlapping connective tissue disorders**

Several patients with hypermobility do not meet any of the new criteria and for these individuals the term Hypermobility Spectrum Disorders (HSD) was coined (Malfait et al., 2017). Patients with HSD usually have musculoskeletal symptoms, although some may have limited multisystem involvement. Both hypermobile EDS and HSD patients feature a myofibroblast-like phenotype with several abnormal extracellular matrix components (ECM), such a different expressions of CCN1/CYR61 and CCN2/CTGF inflammation mediators, an altered organization of α-smooth muscle actin cytoskeleton, and increased levels of the ECM-degrading metallo-proteinase-9, among others (Zoppi et al., 2018). Hypermobility Spectrum Disorders are divided into generalized (G-HSD), peripheral (P-HSD), localized (L-HSD), and historical (H-HSD) subtypes. The genetic basis, prevalence and incidence of HSDs are not known.

Historically, EDS and HSD have been poorly recognized by healthcare providers. In 2005, only 10% of physicians referring their hypermobile EDS patients to rheumatology clinics realized that joint hypermobility was the underlying cause of their patients' pain (Adib et al., 2005). Many physiotherapists are not aware of the condition (Palmer et al., 2016), although EDS is a common, heritable trait seen in up to 10%–30% of

males and 20%-40% of females (A. Hakim & R. Grahame, 2003). Ehlers Danlos Syndrome is the most common inherited connective tissue disorder with approximately 1 in 5000 births (Tinkle et al., 2017), compared to 1 in 3000-10000 for Marfan Syndrome (Pyeritz, 2017), and 1 in 10000 -15000 for Osteogenesis Imperfecta (Lafage-Proust & Courtois, 2019; Morello, 2018). The hypermobile type of EDS is characterized not only by hypermobility, but also by chronic pain, dysautonomia, chronic fatigue, anxiety, and other associated symptoms, and represents at least 80%-90% of all EDS cases (Tinkle et al., 2017). Many patients with hypermobile EDS experience significant levels of disability, which is highly correlated with both physical and psychological factors (Scheper et al., 2016).

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As part of the differential diagnostic process, patients must be screened for possible neurological complications resulting from tissue weakness, biophysical deformative stresses, entrapments, and tissue deformations (Henderson et al., 2017). Comorbid conditions reported with hypermobile EDS include Chiari malformations with or without tethered cord syndrome (Milhorat et al., 2007) and craniocervical instability with or without ventral brainstem compression (Henderson et al., 2018). Other common comorbidities include mast cell activation syndrome (Seneviratne et al., 2017), gastrointestinal dysfunction (Botrus et al., 2018), and postural orthostatic tachycardia syndrome (POTS) (Bonamichi-Santos et al., 2018).

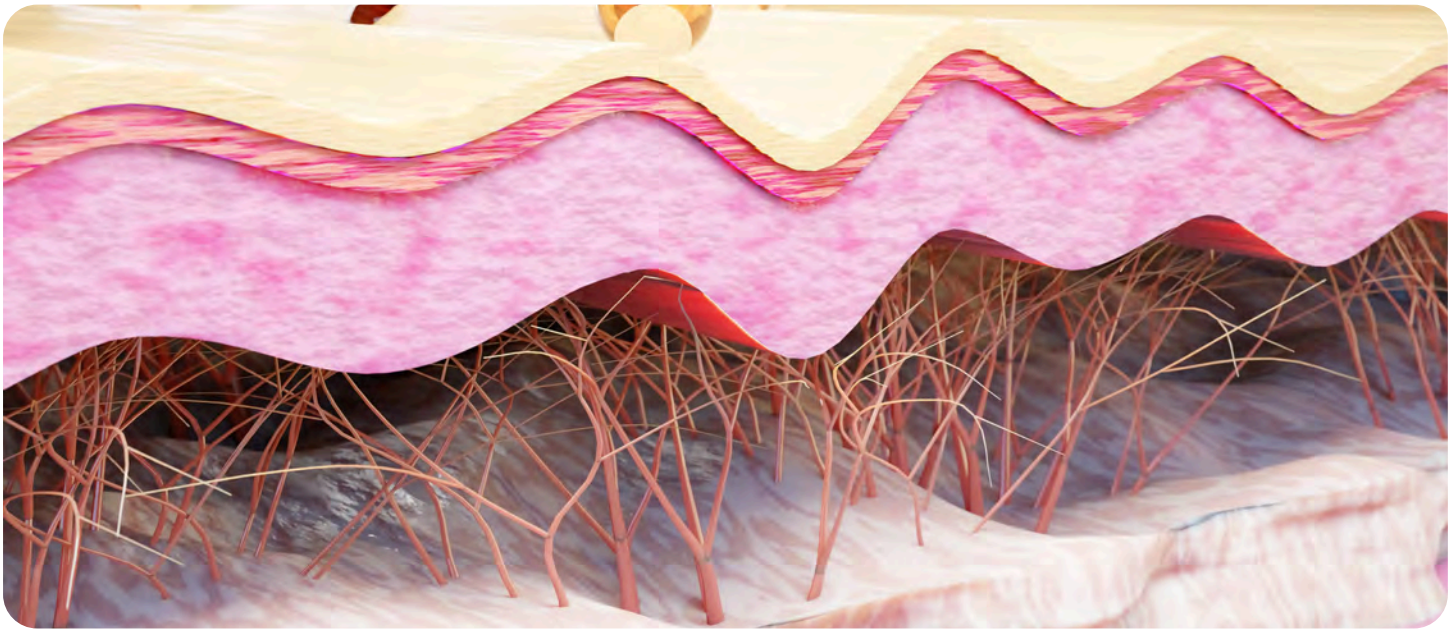
Dry Needling

Since pain is very common in patients with EDS and HSD, DN may seem like an excellent treatment option, but some caution is warranted. Managing pain in hypermobile patients can be quite challenging and often requires a multimodal interdisciplinary approach (Revivo et al., 2018; Zhou et al., 2018), that may include manual therapy, such as trigger point therapy and soft tissue mobilizations (S. Tewari et al., 2017), pain science education (Louw, 2016), cognitive, emotional, and behavioral therapy (Baeza-Velasco et al., 2018), and external-focus exercise therapy (Wulf & Lewthwaite, 2016; Wulf et al., 2018). The role of DN for hypermobile patients has not been scientifically confirmed, but based on our extensive clinical experience with hypermobile patients, DN can be an important aspect of physiotherapy for patients with HSD and EDS especially for reducing pain (Langevin et al., 2024). Our physiotherapy center, Bethesda Physiocare (Bethesda, Maryland, USA), is one of only 22 centers in the world recognized as an EDS Centers & Networks of Excellence (Figure 2) and we have treated thousands of patients with EDS/HSD. As a side note, currently there are only three EDS Centers & Networks of Excellence in Australia (https://www.ehlers-danlos.com/centers-of-excellence/current-cne/).

CENTERS & NETWORKS OF excellence

Trigger point injections were recommended in a case report from India (Saipriya Tewari et al., 2017). Studies comparing TrP injections with DN show many similarities in outcomes, but these studies are usually non-pragmatic with limited clinical applicability and methodological flaws (Cummings & White, 2001; Griswold et al., 2023; Kara et al., 2024; Nagarajan et al., 2022; Navarro-Santana et al., 2022; Nowak et al., 2021). As mentioned in the introduction, there is a risk that DN may reduce the patient's joint stability especially when that patient uses contractures for stabilization. Because it is sometimes difficult to predict how a patient with EDS will respond to DN, we recommend treating only a few muscles or maybe just a few TrP points during the first treatment sessions combined with pain science education (Bonatesta et al., 2022; Chimenti et al., 2023; Diener et al., 2016). Once a patient's pain level has reduced, therapy must include progressive or graded loading, improving loading tolerance, and reducing kinesiophobia (Dommerholt et al., 2019; Priore et al., 2019; Vaegter et al., 2018).

Another question is whether physiotherapists should needle stiffer areas, for example sections of the spine, in hypermobile individuals. It is possible that the stiffer areas are more "normal" or functional, yet, the relatively stiffer areas are also common causes of myofascial pain (Langevin et al., 2024). Another aspect to consider with needling patients with EDS is that connective tissues, and especially fascia, are organized differently compared to patients without hypermobility (Wang & Stecco, 2021). In hypermobile EDS patients, the extracellular matrix changes exhibits reduced inter-fascial plane gliding (Wang et al., 2023), which is a bit surprising as previously, decreased fascial gliding was primarily associated with a loss of flexibility (Cruz-Montecinos et al., 2015). Type I collagen and hyaluronan are important for fascial force transmission and fascial gliding, promoting sliding of adjacent fascial tissue layers (Fede et al., 2021), but excessive hyaluronan can lead to stiffness of the ECM (Mambetsariev et al., 2010). Hyaluronan or hyaluronic acid is a key component of the ECM found in vertebrate tissues (Cowman et al., 2015), including in joint synovial fluid, where it provides lubrication and viscoelasticity to protect cartilage surfaces. The reduced gliding ability found in EDS patients may explain at least partially the widespread pain, but it may also impact proprioception and the ability to generate force and contract muscles efficiently (Cowman et al., 2015; Stecco et al., 2010).



Up to 40% of muscle force is transmitted via fascia, especially the epimysium, and not through tendons (Huijing, 2009; Yucesoy et al., 2003). When connective tissues have significant laxity, forces may not get transmitted to adjacent fascial layers (Langevin et al., 2024). The changes in fascial gliding may be due to an increase in type I collagen and pathologic changes in matrix metalloproteinases in the ECM (Chiarelli et al., 2021), which likely results in increased viscosity, reduced lubrication and sliding movement of fascia (Cowman et al., 2015). It is conceivable that fascial needling approaches, including winding fascial needles in fascial tissues (Langevin et al., 2006; Langevin et al., 2007), or Fu Subcutaneous Needling (Huang et al., 2022; Xiao et al., 2013; Xu, 2020), may be beneficial to patients with EDS. The theoretical basis for using needles in the treatment of fascial adhesions and scar tissue has developed sufficiently to consider its use in the clinic (Chiquet et al., 2003; Finando & Finando, 2011; Grinnell, 2003; Langevin et al., 2011; Pirri et al., 2022; Rozenfeld et al., 2020) and conceivably, these techniques may also be useful for patients with EDS, but there is no research to support this notion.

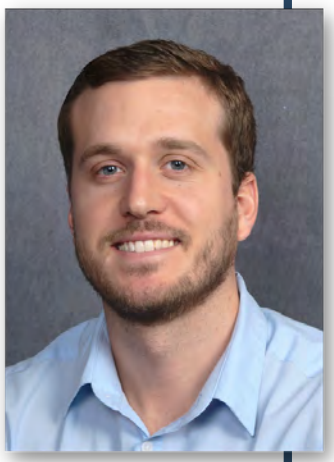
As hypermobile patients get older, it is likely that they will become less hypermobile, mostly because the percentage area of collagen 1 increases significantly with aging leading to a stiffening of the ECM (Fede et al., 2022; Pavan et al., 2020). In post-menopausal women, lower levels of β-estradiol lead to an increase in collagen 1 fibers and a decrease in collagen-III and elastic fibers (Fede et al., 2019). The stiffer ECM and lower estrogen levels is linked to an upregulation of insulin growth factor 1 (IGF-1), which further enhances the synthesis of collagen I (Hansen, 2018).

There is also some evidence that part of aging is associated with a decrease in the percentage of elastic fibers in the perimysium and a decrease in hyaluronan (Fede et al., 2022). Older skin has less hyaluronan than younger skin (Laurent & Tengblad, 1980). Another contributing factor is the presence of the Yes-associated protein (YAP), which is expressed particularly in the deep fascia where it is involved with fascial mechanotransduction, remodeling, regeneration, and fibrogenesis (Pirri et al., 2023). There is some evidence that YAP may be involved in fascial fibrotic changes, but more research is needed (Pirri et al., 2023).

ABOUT THE AUTHORS

Dr. Jan Dommerholt is an accomplished and experienced Dutch-trained physical therapist. In addition to his physical therapy education, he has studied at New York University, where he completed a course of study in Performing Artists Disorders (NYU Human Performance Analysis Laboratory). He completed a Master of Professional Studies with a concentration in biomechanical trauma and health administration from Lynn University and a Doctorate in Physical Therapy from the University of St. Augustine for Health Sciences. Dr. Dommerholt is also a former Diplomate of the Academy of Integrative Pain Management (before the society went out of business) and a member of several medical and physical therapy professional organizations.

Dr. Dommerholt is a Lecturer at the University of Maryland, School of Medicine, Department of Physical Therapy & Rehabilitation Science, Baltimore, MD, and an International Advisor and Honorary Faculty of the Department of Physiotherapy, School of Rehabilitation, Tehran University of Medical Sciences, Tehran, Iran.



Dr. Nathan Mayberry received his Doctorate in Physical Therapy from the University of Maryland in Baltimore. He is among the distinguished 10% of physical therapists who are board-certified specialists in orthopedics. He has worked with a wide variety of patients, ranging from individuals with chronic pain to professional athletes. Dr. Mayberry is well-versed in the assessment and management of patients with numerous chronic pain conditions such as head/neck pain, hypermobility, fibromyalgia, TMJ disorders, headaches, pelvic pain and many patients that have failed “traditional therapy”. His post-graduate training includes training/mentorship with esteemed physical therapists Jan Dommerholt and Gerard Greene (UK). As a result, Dr. Mayberry is accustomed to treating complex cases.

Dr. Mayberry is recognized as a specialized practitioner of dry needling by the Maryland Board of Physical Therapy Examiners. Additionally, he serves as faculty for Myopain Seminars, the world’s leader in dry needling/trigger point education.

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