BEYOND THE SITE OF PAIN: FASCIAL CONTINUITY AND INTEGRATED CLINICAL REASONING IN MANUAL THERAPY

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Abstract: Manual therapy commonly begins at the site where pain is reported. This local approach remains clinically useful, but recurrent symptoms may indicate that the painful region does not contain every factor involved in the problem. Fascia forms a continuous and innervated connective tissue network involved in force transmission, tissue sliding, sensory input, and cellular adaptation. Its relationship with neural, vascular, and immune processes offers a possible framework for understanding why local symptoms may be influenced by regional or wider factors. Manual contact may also produce neurophysiological and contextual responses that cannot be attributed to structural tissue change alone. This narrative article examines how fascial continuity, mechanotransduction, biotensegrity, and pain regulation may contribute to clinical reasoning in manual therapy. The proposed approach does not replace local assessment or treatment. Instead, it suggests that the behaviour and recurrence of symptoms should guide the clinician in deciding when a wider, individual evaluation is required.

Keywords: fascia; manual therapy; fascial continuity; mechanotransduction; persistent pain; clinical reasoning.

Introduction

Pain is usually presented as a local experience. A patient identifies a particular area, and

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clinical attention naturally moves in that direction: the region is examined, movement is tested, sensitive structures are identified, and an intervention is selected. When manual treatment reduces pain and improves function, this local approach has clear value. The situation becomes less simple when the patient returns with the same complaint. Treatment may have helped considerably, but its effect did not last. Repeating the intervention can still provide relief, yet it may not explain why the symptom continues to return. Current approaches to musculoskeletal pain recognise that persistent symptoms may involve more than one damaged structure, and clinical guidance recommends considering function, general health, patient preferences, and factors that may influence pain over time (Ernstzen et al., 2017). Pain management has also moved towards models that integrate biological, psychological, and social information without rejecting physical assessment or the relevance of local tissues (George, 2017; Pomarensky et al., 2022).

Fascial research may contribute to this broader view. Once treated mainly as passive material around muscles and organs, fascia is increasingly described as a continuous, innervated, and biologically active connective tissue system. It may participate in mechanical integration, sensory processing, extracellular matrix regulation, and interactions with vascular and immune structures (Fede et al., 2022; Huang et al., 2026; Slater et al., 2024). Myofascial continuity also suggests that structures commonly examined as separate units can participate in wider anatomical and functional relationships (Ajimsha et al., 2020; Kalichman, 2025; Noten & van Amstel, 2024). These findings are relevant to manual therapy because the clinician applies a local mechanical and sensory input, while the patient's response may include changes in perception, movement, muscle activity, autonomic regulation, and expectation. They do not prove that a distant fascial restriction causes local pain. Rather, they support examining the painful region as part of a connected and responsive person.

The purpose of this article is to consider how current knowledge of fascial continuity and regulation may expand clinical reasoning when symptoms are recurrent or not completely explained by their location. Treatment of the painful site remains part of this approach; the main difference is that the patient's response becomes clinical information rather than proof that one structure has been corrected.

Narrative approach and scope

This is a clinical narrative review rather than a systematic review. It integrates peer-reviewed anatomical, cellular, experimental, clinical, and review literature directly relevant to fascial continuity, manual therapy mechanisms, persistent pain, and clinical reasoning. Greater weight is given to human research, systematic and scoping reviews, and sources that clearly separate anatomical plausibility from clinical causation. Animal, cadaveric, narrative, and conceptual evidence is included where it informs mechanism or interpretation, but its limits are stated. The article does not attempt to grade treatment effectiveness or provide a technique-specific protocol.

From local anatomy to fascial continuity

Why fascial continuity matters

Anatomy divides the body into structures so that it can be studied and communicated. Muscles, bones, joints, nerves, and organs require individual names and descriptions, but in the living body these structures are not separated in the same way they appear in textbooks. Connective tissue extends from the skin and superficial fascia into deeper fascial layers, muscle compartments, tendons, ligaments, periosteum, and joint-related tissues. The ArthroMyoFascial complex presents these layers as parts of a connected anatomical organisation, maintaining the distinction between muscle, fascia, and joint while showing that movement and mechanical input can involve several tissue layers simultaneously (Noten & van Amstel, 2024).

Histological descriptions also show that skeletal muscle and its connective tissue framework form an integrated structural unit. Endomysial, perimysial, and epimysial tissues organise fibres and continue towards aponeurotic, myotendinous, and fascial structures. Tendons, aponeuroses, and fasciae differ in collagen organisation and function, but their continuity influences how load is distributed across the muscle–tendon–fascia interface (Pedret et al., 2025). A muscle injury should therefore not always be interpreted as damage to contractile fibres alone.

Myofascial continuity describes structural and functional connections between muscles through connective tissues. Anatomical and cadaveric evidence supports the existence of several connections and indicates that force may be transmitted beyond the conventional origin–insertion pathway (Ajimsha et al., 2020; Kalichman, 2025). Their clinical importance in a living patient is more difficult to determine because cadaveric research cannot reproduce active contraction, circulation, nervous system regulation, or the adaptive behaviour of a person moving in a real environment. Anatomical continuity shows that a pathway exists; it does not establish that the pathway is responsible for an individual patient's pain. Continuity should therefore influence the questions asked during assessment rather than decide the answer before the patient has been examined.

Components and functions of the fascial system

The fascial system contains connective tissue cells, collagen and elastin fibres, water, and a hydrated extracellular matrix containing glycosaminoglycans such as hyaluronan. Neural, vascular, and immune elements are also found within or closely associated with these tissues (Fede et al., 2022; Huang et al., 2026; Slater et al., 2024). Collagen contributes to mechanical resistance and force transmission, while elastin supports reversible deformation. The extracellular matrix provides an environment in which cells, fibres, fluids, and signalling molecules interact, and fibroblasts respond to local mechanical and biochemical conditions (Kirkness & Scarlata, 2026; Slater et al., 2024).

Fascial properties are not fixed. Movement, repeated loading, immobilisation, inflammation, injury, and ageing may influence tissue organisation, stiffness, and sliding capacity. These changes can be adaptive when they help tissue manage functional demand, but under different conditions they may contribute to fibrosis, altered mobility, or sensitivity (Huang et al., 2026; Kirkness & Scarlata, 2026; Stecco et al., 2023). The evidence is stronger for the general capacity of connective tissue to adapt than for identifying a single clinically measurable state called “fascial dysfunction.”

Fascial function is also related to sensory processing. Human superficial fascia contains myelinated and unmyelinated nerve structures as well as markers of autonomic innervation (Fede et al., 2022). This finding supports a role in detecting pressure, deformation, and changes in the local tissue environment. The presence of neural structures does not mean that every fascial change generates pain, nor does tenderness during palpation identify fascia as the definite source of a symptom. It shows more cautiously that fascial tissues may participate in proprioception, interoception, nociception, and local physiological regulation. Manual pressure therefore enters a living tissue environment capable of receiving mechanical information and interacting with neural and cellular responses.

Force transmission and biotensegrity

Traditional biomechanics provides effective methods for measuring joint motion, torque, acceleration, and external load. These methods require the body to be divided into understandable segments and remain essential in research and clinical practice. Biotensegrity offers a complementary conceptual perspective by describing relatively rigid elements operating within a continuous network of tension. From this view, stability and force distribution emerge from relationships across the wider system rather than from compression at individual joints alone (Scarr, 2020).

The concept is useful for visualising continuity, but it should not be treated as a validated clinical treatment model. Evidence for fascial connectivity and force transmission supports some system-level relationships, while their magnitude, direction, and relevance vary with anatomy, task, loading, and individual condition (Ajimsha et al., 2020; Kalichman, 2025). Biotensegrity cannot identify which distant structure should be treated for a particular symptom, and current evidence does not show that interventions described as biotensegrity-based are superior to conventional approaches. Classical biomechanics and biotensegrity need not compete: one offers measurable information about segments and forces, while the other draws attention to continuity and distributed organisation. The latter is best used as a cautious explanatory model, not as proof of a technique.

Limits of structural interpretation

Because fascia is continuous, it is tempting to interpret every distant relationship as mechanically important. This risks replacing one narrow model with another. Instead of assuming that all pain comes from a local lesion, the clinician may begin assuming that it comes from a hidden fascial chain even when the examination does not support that conclusion. Anatomical relationships vary, and their influence depends on movement, load, tissue condition, and sensory regulation. Pain is not a direct measurement of force transmission: structural change may exist without pain, and significant pain may occur without a clear structural lesion (George, 2017; Pomarensky et al., 2022).

Palpation presents a similar challenge. Clinicians may identify tenderness, movement responses, and differences in tissue resistance, but these findings depend partly on pressure, position, and interpretation. No widely accepted quantitative reference standard defines fascial dysfunction. Ultrasound, elastography, tissue mechanics, and other measures may complement examination, but their relationship with symptoms and treatment decisions is still developing (Huang et al., 2026). Palpation can therefore remain one source of clinical information without implying that the hands identify a precise microscopic abnormality.

Fascia, movement, and manual therapy

Hyaluronan and tissue sliding

Hyaluronan is an important component of the fascial extracellular matrix. Its interaction with water and other matrix components contributes to sliding between tissue layers, while molecular weight, concentration, temperature, inflammation, and interactions with collagen may influence its behaviour (Kirkness & Scarlata, 2026; Slater et al., 2024; Stecco et al., 2023). Describing hyaluronan simply as changing from a lubricant into an adhesive substance is clinically attractive but biologically incomplete.

Mechanical stress can influence extracellular matrix organisation and hyaluronan fragmentation, providing a possible link between loading, inflammation, and fascial adaptation. However, the proposed relationship between deep manual friction, hyaluronan fragments, and restoration of tissue sliding is based mainly on a narrative synthesis and biological plausibility rather than direct clinical measurement (Stecco et al., 2023). A therapist cannot identify the molecular state of hyaluronan through the skin. A perceived reduction in resistance after treatment may involve altered muscle activity, sensory modulation, temperature, fluid movement, expectation, or changes in tissue behaviour. More than one process may occur, and the observation may remain useful without assigning it to a confirmed molecular mechanism.

Mechanotransduction and adaptation

Cells detect aspects of their mechanical environment. Through mechanotransduction, compression, stretch, shear, and matrix stiffness can be converted into intracellular responses affecting the cytoskeleton, extracellular matrix production, repair, and adaptation (Potekhina et al., 2020). The calcium–hyaluronan axis has been proposed as a testable framework in which mechanical stimulation activates mechanosensitive channels and calcium signalling, influencing hyaluronan synthesis and receptor activity (Kirkness & Scarlata, 2026).

This framework provides a biologically plausible connection between physical load and fascial regulation, but an important translational gap remains. Much of the evidence comes from mesenchymal cells and fibroblasts studied under experimental conditions. Responses specific to human fasciacytes and hands-on interventions require validation, and no established pressure, duration, direction, or frequency is known to produce a particular beneficial cellular response (Kirkness & Scarlata, 2026;

Potekhina et al., 2020). Mechanotransduction supports the possibility that manual input participates in tissue adaptation; it does not validate every manual technique or permit a specific cellular outcome to be claimed after treatment.

Manual contact as a mechanical, sensory, and contextual event

Manual therapy is often explained through structural language: a technique is said to lengthen a muscle, mobilise a joint, or release fascia. These descriptions may represent one part of treatment, but they are unlikely to describe the complete event. The hands stimulate skin and superficial receptors before force reaches deeper tissues. At the same time, the patient interprets the contact through previous experiences, expectations, communication, and the clinical environment (Bonanno et al., 2024; Wilson et al., 2023).

Research in animal models has identified responses to manual procedures involving peripheral tissues, spinal pathways, autonomic activity, immune processes, and neuroendocrine mechanisms (Lima et al., 2020). These models permit controlled investigation but cannot be transferred directly into claims about human care. A systematic review of spinal manual therapy in humans found variable short-term changes in pain perception, central nervous system activity, and autonomic responses; small samples, limited blinding, and inconsistent effect-size reporting reduced certainty (Jupin et al., 2025).

Context also belongs to the treatment rather than sitting outside it. In an experimental massage study, expectations influenced changes in pressure-pain sensitivity, although participants were healthy and the findings cannot be assumed to apply directly to chronic pain populations (Wilson et al., 2023). Qualitative research in musculoskeletal care likewise emphasises two-way communication, patient participation, feedback, and therapeutic alliance, while recognising that these observations do not quantify treatment efficacy (Arrigoni et al., 2024). Manual contact should therefore be understood as a combined mechanical, sensory, interpersonal, and contextual event.

A broad systematic review and meta-analysis of 88 trials and 5,524 participants reported improvements across pain and selected physical, psychological, and physiological outcomes (Mo et al., 2026). However, it combined massage, reflexology, joint mobilisation, osteopathic approaches, and myofascial techniques across different populations and comparators. These findings indicate that diverse manual interventions may offer benefits in some contexts; they do not establish a uniform effect, a fascial mechanism, or equivalent effectiveness for every intervention.

Fascial regulation, pain, and clinical reasoning

Innervation and neuroregulation

Fascial tissues contain sensory structures capable of detecting mechanical and biochemical change. Their association with autonomic fibres, local vessels, and immune elements places them within a wider regulatory environment (Fede et al., 2022; Huang et al., 2026; Slater et al., 2024). Mechanical input may alter sensory information before a patient reports improved pain or movement, providing one possible explanation for rapid responses during treatment. A tissue cannot be completely remodelled in seconds, yet the patient may immediately feel safer or move more comfortably. This response matters clinically, but it does not confirm that a fixed structural fault has been corrected.

Touch-based interventions may influence pain through sensory, affective, and autonomic processes as well as tissue deformation (Bonanno et al., 2024; Jupin et al., 2025). The relevant shift is not from a mechanical explanation to a neurological one, but from single-mechanism explanations towards interaction between several processes.

Pain, sensitisation, and expectation

Persistent pain may involve increased sensitivity within peripheral or central sensory pathways. Central sensitisation can be relevant to some presentations, but it should not be used as a general label for everyone with recurrent pain. A network meta-analysis distinguished self-reported symptoms measured by the Central Sensitisation Inventory from pressure-pain thresholds, showing that they are related but do not represent the same construct. Pain neuroscience education showed favourable findings for pressure-pain threshold, while certainty for several patient-reported comparisons was lower (Hua et al., 2026). A pressure-pain threshold is a quantitative measure of sensitivity, not a stand-alone diagnosis of central sensitisation.

Sensory attenuation may provide another part of the explanation because the nervous system continually regulates the importance given to incoming information. Changes in this process have been discussed in persistent physical symptoms, functional neurological disorders, and chronic pain, but the evidence remains exploratory and does not establish a manual therapy mechanism (Rossi et al., 2025). Pain is not imagined; it is actively produced and regulated rather than functioning as a direct measurement of tissue damage.

Expectations and clinical language can influence treatment response. Explanations suggesting that the patient's body is displaced, fragile, or blocked may increase concern and dependence. A more adaptable explanation can recognise sensitivity while encouraging movement and participation. Pain neuroscience education and manual therapy do not need to compete: hands-on treatment may reduce sensitivity or make movement feel safer, while education may help the patient understand pain and become more active (Louw et al., 2017).

When recurrent symptoms require a wider view

When local treatment produces lasting improvement, there may be little reason to make the clinical model more complicated. The painful region was assessed, the intervention helped, and function recovered. Recurrence changes the available information. If the same symptom improves and repeatedly returns, the response may indicate that pain is modifiable while relevant contributing factors remain. These factors may still be local, such as repeated loading or limited capacity, but they may also include regional movement, wider sensitivity, fear, recovery, sleep, fatigue, or daily demands (Ernstzen et al., 2017; George, 2017; Pomarensky et al., 2022).

These wider factors should not be assumed from pain alone. In a cross-sectional primary-care study, people with chronic musculoskeletal pain reported more anxiety, depression, fatigue, and insomnia than people without chronic musculoskeletal pain, and symptom burden increased with pain intensity and the number of pain sites. The design demonstrates association rather than causation, but it supports asking relevant questions when the clinical pattern indicates a need (Garnæs et al., 2022).

A wider assessment should not become a routine search through every body system. It should be directed by history, examination, and response to treatment: how long improvement lasts, whether symptoms return during a specific activity, whether other regions are sensitive, and whether treatment changes meaningful function rather than pain alone. This interaction-based reasoning can be achieved through established biopsychosocial and person-centred principles without requiring a hidden distant lesion (George, 2017; Pomarensky et al., 2022).

Possible visceral and somatic relationships may occasionally deserve consideration. A scoping review of visceral manual therapy included nine heterogeneous studies and 326 participants; small samples, inconsistent outcome measures, and incomplete safety reporting limit confidence (Goldenberg et al., 2025). This evidence is not sufficient to claim that visceral restriction commonly causes musculoskeletal pain. When visceral symptoms are present, careful history-taking, screening, and referral are more appropriate than forcing them into a fascial explanation. Moving beyond the site of pain means recognising when the local explanation is incomplete, not searching automatically for a distant fault.

Response-led clinical decision-making

An integrated approach still begins locally. The clinician examines the painful region, tests movement, and considers whether manual therapy is appropriate. The intervention is applied with a clear purpose, and the response becomes part of the assessment. A meaningful change suggests that the intervention influenced something relevant, but it does not prove that one exact structure was repositioned or released. A brief response may show that symptoms can be modulated while factors maintaining them remain. No response should encourage reconsideration rather than automatic application of greater pressure or more techniques.

The assessment can then expand in proportion to the case, exploring nearby regions, load tolerance, non-local sensitivity, recovery, expectations, and the patient's understanding of pain. Treatment may combine manual therapy, movement, education, and supported self-management according to what is found (Louw et al., 2017; Pomarensky et al., 2022). A survey of 569 physical therapists found that clinicians attributed manual therapy effects to a mixture of brain, myofascial, peripheral neural, placebo, muscular, and neuromuscular mechanisms. These findings describe professional beliefs rather than proving mechanisms, reinforcing the need to separate clinical experience from evidence while allowing observations to generate useful questions (Carvalho et al., 2025).

Research methods provide another reason for caution. Sham controls and blinding are difficult in trials of physical and psychological interventions because touch, attention, credibility, and expectation are not easily separated from an active manual procedure (Hohenschurz-Schmidt et al., 2023). This does not make every technique equivalent. It means that outcomes arise from the complete clinical event, while the contribution of each component remains difficult to isolate.

Conclusion

Implications for practice and research

Fascial continuity provides an anatomical basis for considering relationships beyond an isolated painful structure. The fascial system can participate in force transmission, movement between tissue layers, sensory input, and adaptation to mechanical and biochemical conditions. Biotensegrity and mechanotransduction offer conceptual and biological perspectives on how local loading may relate to wider organisation. The available evidence, however, does not support fascia as a single explanation for recurrent pain or show that manual therapy selectively corrects a body-wide fascial dysfunction. Mechanical, neural, autonomic, contextual, and behavioural processes may participate in the response at the same time.

For practice, local treatment remains a reasonable starting point. Its value should be judged by outcomes that matter to the patient, including pain, movement, confidence, function, and duration of improvement. When symptoms repeatedly return, recurrence can be treated as information and may justify reconsidering the original explanation and investigating relevant regional, sensory, behavioural, and general factors.

Future research should define interventions precisely, including technique, dose, force where measurable, duration, frequency, comparator, and therapist–patient interaction. Credible controls, adequate samples, transparent effect sizes, longer follow-up, and clinically meaningful outcomes are needed. Anatomical and cellular research should also be connected more carefully with human clinical evidence. The most useful question may not be whether manual therapy changes fascia in general, but which patient responds, what changes during that response, how long improvement lasts, and what should happen next. Pain is experienced in a particular place. Clinical reasoning starts there, but recurrent pain may ask the clinician to look further.

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