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Is Central Sensitization an Explanation or a Conclusion?

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Abstract

This article distinguishes observation, explanation, and conclusion in research on sensory amplification in fibromyalgia. Multiple evoked-pain measures can be used to study the involvement of sensory facilitation and modulation, but they are not a single interchangeable test. The quality assessment in a 34-study review, protocol and site heterogeneity in a scoping review that included 126 of 2,512 records, and discordance between self-report and QST in a 22-participant comparison all limit mechanistic and individual-level conclusions. The current evidence does not establish central sensitization as a sole or exclusively central cause, an individual diagnostic criterion, a pain-validity test, or a stable temporal marker. Longitudinal designs that repeatedly measure standardized sensory responses alongside symptoms and function in the same people are needed to distinguish causal direction and subgroups.

Keywords: fibromyalgia central sensitization · fibromyalgia QST · quantitative sensory testing · sensory amplification · conditioned pain modulation · temporal summation · fibromyalgia cause · pain testing

Observation, Explanation, and Conclusion

Quantitative sensory testing (QST) is a psychophysical method that applies mechanical or thermal stimuli of specified intensity and quantifies the resulting somatosensory responses. [2, 3] It records how a person perceived and responded to a stimulus under particular conditions. It does not directly image or sample tissue damage or a single lesion in the nervous system.

When those responses show patterns such as temporal summation, reduced inhibition, or a lower threshold, researchers can ask whether pain-facilitation and pain-modulation processes are involved. This is the first step from observation toward explanation. No single measure, however, establishes by itself the sole cause of fibromyalgia, the condition in its entirety, or whether reported pain is genuine. [1, 2, 3]

“Central sensitization may be involved” is therefore not the same statement as “central sensitization is the cause.” The former is a research explanation based on functional responses observed under test conditions. The latter is a conclusion that also establishes the mechanism's location, causal direction,

and sufficiency. The current evidence allows the first statement to be examined but does not warrant the second. [1, 2]

Involvement Indicated by Multiple Measures

A 2022 systematic review of algometry examined several measures across 34 studies, including temporal summation, after-sensations, spatial summation, nociceptive flexion reflex threshold, conditioned pain modulation, the cutaneous silent period, and slowly repeated evoked pain. [1] This list shows that sensitization has been studied not as a single number but through distinct observations of facilitation, inhibition, persistence, and reflex activity.

The review concluded that these measures could be used to investigate the involvement of central sensitization in fibromyalgia. [1] "Involvement" is the important word. It means that a response evoked in the laboratory may reveal one aspect of sensory processing, not that the same process operates to the same degree in every patient.

The quality of the evidence must be read alongside these findings. Of the 34 studies assessed in the same review, 28 were classified as low quality, three as moderate quality, and three as high quality. [1] The repeated study of multiple measures demonstrates the breadth of the research program, but their number alone does not yield strong mechanistic certainty or predictive power for an individual.

Different Processes Under One Umbrella

Temporal summation, conditioned pain modulation, pressure pain threshold, after-sensations, and reflex thresholds are different evoked-pain measures. [1] Even when they are placed under the single heading of "central sensitization," they are not identical tests that can be used interchangeably.

The boundary is not anatomically simple either. A 2025 scoping review noted that temporal summation and conditioned pain modulation are commonly used as measures of central sensitization, but the peripheral nervous system is involved as well. [2] Translating a difference in one measure directly into a change arising only in the central nervous system therefore exceeds what the measurement permits.

Central sensitization can serve as an umbrella for organizing different findings and designing the next experiment. The umbrella is not itself a conclusion. Whether different measures occur together in the same person, reflect the same biological process, or change alongside symptoms must each be tested separately. [1, 2]

When the Protocol Changes, Meaning Becomes Unstable

The 2025 scoping review screened 2,512 records and included 126 studies. [2] Those numbers reveal a broad research landscape, but common protocols were not applied consistently, and test sites and test types varied. A large body of research does not mean that its findings can be compared on a single scale.

When stimulus type and intensity, duration, rest intervals, equipment, test site, and reference values differ, tests with the same name record different conditions. [2, 3] The NeuPSIG consensus called for predefined stimuli and instructions, validated testing algorithms, reference values adjusted for anatomical site, age, and sex, and interpretation in clinical context. [3]

This heterogeneity is not merely a matter of formatting. Values obtained under different conditions limit synthesis across studies and reliability as a biomarker. [2] Interpretation should therefore begin not with the shorthand label “sensitization positive,” but with what was measured, where, by which procedure, and against which reference population.

From Group Research to Individual Classification

QST can provide supplementary information about somatosensory function, but it is not a stand-alone device for establishing an individual's diagnosis. Even within its own context of neuropathic pain, the NeuPSIG consensus did not recommend QST as a stand-alone diagnostic test. [3] That statement should not be transferred into a fibromyalgia-specific guideline, but it clearly marks the boundary between measuring function and establishing a diagnosis.

In fibromyalgia research, that boundary calls for more specific thresholds. We would need to know how accurately a given combination of tests, sites, and reference values distinguishes individuals, whether the same responses occur in other pain conditions, and whether classifications persist on repeat testing. The current scoping review mapped the methods; it did not validate that kind of individual diagnostic accuracy. [2]

There is also no basis for using a test value to judge whether pain is genuine. QST records responses to evoked stimuli and does not capture spontaneous pain in its entirety. [2, 3] If an expected change is absent, the conclusion should remain that the change was not observed with that protocol at that site.

Discordance as Counterevidence and a Question

The Tampin study asked 22 participants with fibromyalgia about the sensory descriptors in painDETECT and measured several QST parameters at the area of maximal pain. [4] In this small sample, the self-reported sensory descriptors did not consistently align with the corresponding QST patterns. The same person could therefore be classified differently by verbal descriptions of sensation and by laboratory responses to evoked stimuli.

That discordance is not a verdict that one side is false. The researchers stated that the reason for the difference was unclear and that the small sample limited generalizability. [4] Findings from this particular questionnaire, test battery, and maximal-pain site cannot be expanded into a universal account of the relationship between all self-reports and all QST measures.

Instead, the result adds counterevidence to the assumption that a single sensitization measure represents the whole of an individual's experience. When symptom descriptions and evoked responses diverge, it remains to be determined whether the difference reflects measurement error, timing or test

site, distinct sensory constructs, or patient subgroups. [2, 4]

The Arrow Between Cause and Effect

A cross-sectional test cannot distinguish whether sensory amplification helps pain persist, whether persistent pain together with sleep, activity, emotion, and treatment context changes evoked responses, or whether both directions operate together. The 2022 review likewise concluded that further research was needed to clarify the mechanisms of some measures and to standardize and optimize protocols. [1]

There is also a large gap in the time dimension. The 2025 scoping review reported that few studies measured QST before and after an intervention, leaving the stability of QST in fibromyalgia poorly understood. [2] Without knowing stability and sequence of change, it is difficult to determine whether a test difference is a preceding cause, a consequence of a state, or a marker that changes alongside it.

The current evidence contains no direct longitudinal study that repeatedly measures multiple standardized QST measures together with symptoms and function in the same people to determine temporal order. Causal direction is therefore neither disproved nor established. It remains an open question because the designs needed to distinguish the direction are still lacking. [1, 2]

Use It as an Explanation Without Closing It as a Conclusion

The safest current summary is this: several evoked-pain measures provide a window for studying the involvement of sensory facilitation and modulation in fibromyalgia. At the same time, evidence quality, differences among measures, heterogeneity of protocols and test sites, peripheral involvement, and the discordance between self-report and QST found in a small study all set an upper limit on interpretation. [1, 2, 4]

Future studies should use the same protocols and reference values, describe patient characteristics and coexisting symptoms, and apply multiple measures repeatedly in the same people. Changes in symptoms and function should be placed on the same timeline to test whether sensory responses come before or after them and in which subgroups they move together. [1, 2, 3] These are design principles for narrowing the gaps, not pathways established by the current evidence.

Central sensitization may be a useful hypothesis for organizing an explanation. A good explanation does not close every question; it helps distinguish which observations hold, which inferences are premature, and what needs to be tested next. An individual's pain does not require permission from a test result to exist, and no single result establishes that person's diagnosis and cause on its own. [2, 3]

Declarations

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Ethics	Only public literature was used; no individual patient data or clinical intervention was involved. Any future human-participant research requires separate ethics review before it begins.

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