Measurement of Trigger Points Using Myotonometry Pre and Post MSTR® treatment evaluation

Alastair McLoughlin

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Executive Summary

This study seeks to evaluate and assess if any patient benefits are derived from the application of a specific physical therapy approach to the treatment of trigger points (TP's).

Evaluation will be performed using myotonometry (MyotonPRO Digital Palpation Device).
Physical therapy treatment used is MSTR® (McLoughlin Scar Tissue Release).

Definitions

Myotonometry / MyotonPro: MyotonPRO offers a non-invasive, reliable and accurate solution for *in vivo* digital palpation of soft biological tissues. The device measures superficial tissue structures, including skin, adipose tissue, skeletal muscles, tendons, or ligaments.

MyotonPRO employs a measurement method defined as the **Mechanical Dynamic Response method**. The method consists of a mechanical precision impulse, the recording of dynamic tissue response in the form of physical displacement and oscillation acceleration signal and the subsequent computation of parameters characterising the State of Tension, Bio-mechanical and Viscoelastic properties.
The MyotonPRO device has already been used in over 300 research reports and studies (https://www.myoton.com/publication/) and is considered a research-grade instrument by many universities, institutions and world-class research centres, such as NASA (https://www.myoton.com/researchers/).

MSTR® - McLoughlin Scar Tissue Release®: A physical therapeutic approach, specifically designed for the treatment of scar tissue. Using light to moderate pressure, applied by the fingers of the operator, the treatment is administered in multiple directions and tissue depths to achieve a separation of the tightly-bound collagen fibres that characterise scar tissue.

Trigger Points - Definition:

Trigger points are defined as discrete, focal, hyper-irritable spots located in a taut band of skeletal muscle. These spots are painful upon compression and can produce referred pain, tenderness, motor dysfunction, and autonomic phenomena.

They are often palpable nodules in the muscle's fascia, and direct compression or muscle contraction can elicit a local twitch response and referred pain patterns.

Typical Locations of Trigger Points

Trigger points can occur in various muscles throughout the body. Common locations include the trapezius, levator scapulae, and infraspinatus muscles in the upper back and shoulder region. These points can refer pain to other areas; for example, trigger points in the trapezius muscle may cause pain in the neck and head regions.

Therapeutic Approaches to Address Trigger Points

Several therapeutic methods are employed to manage and alleviate the symptoms associated with trigger points:

1. **Manual Therapy**: Techniques such as massage, myofascial release, and stretching are used to relieve muscle tension and promote healing.

2. **Trigger Point Injections**: This procedure involves the injection of a local anaesthetic, saline, or corticosteroid directly into the trigger point to alleviate pain.
3. **Dry Needling**: A technique where fine needles are inserted into the trigger points without injecting any substance, aiming to release muscle tightness and reduce pain.
4. **Counter-strain Technique**: Also known as strain / counter-strain, this method involves positioning the patient to minimise discomfort, holding the position to allow the muscle to relax, and then slowly returning to a neutral position.

Additional information:

The exact pathophysiology of TrPs remains under investigation, but several mechanisms have been proposed:

1. **Excessive Acetylcholine Release**: Anomalies at the neuromuscular junction may lead to continuous release of acetylcholine, resulting in sustained muscle fibre contraction and the formation of taut bands characteristic of TrPs.
2. **Biochemical Changes**: Elevated levels of inflammatory mediators, such as substance P, calcitonin gene-related peptide (CGRP), bradykinin, tumour necrosis factor-α (TNF-α), and interleukin-1β (IL-1β), have been detected in the vicinity of active TrPs, contributing to localised pain and sensitisation.

Impact on Fascial, Dermal, and Underlying Structures

The development of TrPs influences various tissue structures:

- **Fascial Tissue**: The fascia, a connective tissue surrounding muscles, becomes involved in the pathological process. Tightening of the fascia can lead to excessive tension and stiffness, further exacerbating muscle pain and dysfunction.

- **Dermis**: While the primary alterations occur within the muscle and fascial tissues, the dermis may exhibit secondary changes. Patients with TrPs often report referred pain that manifests in skin regions distant from the actual trigger point, indicating a complex interplay between deep muscle tissues and superficial dermal structures.
- **Underlying Structures**: TrPs can affect adjacent anatomical components, including nerves and blood vessels. The sustained muscle contraction associated with TrPs may compress nearby nerves, leading to symptoms such as tingling, numbness, or weakness. Additionally, vascular structures may be compromised, potentially reducing blood flow and contributing to ischemic conditions within the affected muscle.

Research Design

We took a group of 15 individuals (13 female, 2 male) at random for the trial. The precise method of measurement and data collection was explained and the MyotonPRO was demonstrated to the subject prior to their agreement to take part in the study.

Patient anonymity was assured, and any possible side-effects from MSTR® treatment were explained. No payment was given or received by the authors of the study, or the test subjects.

Trigger-points were identified and marked using an indelible pen so the exact location could be measured post-treatment.

The subject was laying prone on a massage table. The head was supported in a face-cradle, ensuring the spine was straight and no torsion of the neck occurred. The trigger-point was treated using MSTR® for a period of between 1 to 2 minutes. Treatment ceased when the operator estimated tissue tension had reduced.

Parameters measured by MyotonPro

1. Oscillation Frequency [Hz]
2. Dynamic Stiffness [N/m]
3. Logarithmic Decrement
4. Mechanical Stress Relaxation Time [ms]
5. Creep [C]

Parameters - explanatory notes

Oscillation Frequency [Hz]

Oscillation frequency, measured in Hertz (Hz), is a way to describe how "tight" or "tense" a soft tissue, like a muscle, is at a very tiny level, specifically at the level of its cells.

When we talk about the oscillation frequency of a muscle in its relaxed or passive state, it tells us how naturally tight or tense that muscle is even when we're not actively using it. Think of it as the muscle's default tension when it's at rest and not being consciously flexed or moved. We can measure this even when the muscle is quiet, meaning there's no electrical activity detected (EMG signal is silent).

On the other hand, when we measure the oscillation frequency of a muscle in its contracted state, it gives us insight into how tense or tight the muscle becomes when we deliberately flex or contract it. This is the level of tension we feel when we actively use our muscles for movements.

In simple terms, oscillation frequency helps us understand how relaxed or tensed a muscle is, whether it's at rest or when we're using it, and it does this by looking at very tiny movements or vibrations happening within the muscle's cells.

In the context of oscillation frequency, a higher frequency generally indicates greater tension or tightness in the muscle.

Dynamic Stiffness [N/m]

Dynamic stiffness, measured in Newtons per meter (N/m), is a way to describe how resistant biological soft tissues are to being deformed or stretched when a force is applied to them.

This term comes from a method called myotonometry, which measures these properties in a dynamic or moving way. In simple terms, dynamic stiffness tells us how much a soft tissue, like a muscle, resists stretching when a force is acting on it, especially when the muscle is in motion.

The "inverse of stiffness" refers to compliance, which is the opposite concept. Compliance is a measure of how easily a soft tissue can be deformed or stretched when a force is applied. So, the higher the dynamic stiffness, the less compliant or more resistant the tissue is to stretching.

A higher value indicates that the tissue is more resistant to deformation, meaning it is stiffer.

Logarithmic Decrement

Logarithmic decrement is a way to measure how quickly the natural oscillation or bouncing of soft tissues slows down. When tissue vibrations fade rapidly, it means that the mechanical energy created by the initial stimulus (like a tap or push) is being lost quickly.

In simpler terms, if the logarithmic decrement is high, it means the tissue's vibrations stop rapidly, indicating that it doesn't bounce or vibrate for long. This is a sign that the tissue is not very elastic.

Elasticity is a property of soft tissues that refers to their ability to bounce back to their original shape after being stretched or deformed. So, if the logarithmic decrement is high, it suggests low elasticity because the tissue isn't bouncing back much.

In contrast, if the decrement is very low (or even zero), it means the tissue is super elastic and doesn't lose its bounce quickly. It's like it can return to its original shape without losing much energy.

The opposite of elasticity is plasticity, which means the tissue retains its deformed shape instead of bouncing back. So, the higher the decrement, the less elastic and more plastic the tissue appears to be.

Mechanical Stress Relaxation Time [ms]

Mechanical stress relaxation time, measured in milliseconds (ms), is a way to describe how long it takes for a tissue to bounce back to its original shape after it has been pushed or stretched.

If a tissue is very tense or stiff, it quickly recovers its shape after being pushed or stretched. So, the mechanical stress relaxation time is low (it happens fast).

On the other hand, if a tissue is less tense or stiff, it takes more time for it to bounce back to its original shape. So, the mechanical stress relaxation time is high (it takes longer).

In summary, this measurement helps us understand how quickly a tissue can recover its shape after being deformed, and it's related to how tense or stiff the tissue is. If it's very tense, it recovers quickly, and if it's less tense, it takes longer.

Creep [C]

The "Ratio of Relaxation and Deformation Time" is a way to measure how much a tissue can stretch or lengthen over time when a constant pulling force is applied to it. It's related to a property called "creep."

Creep is when a tissue gradually stretches out over time when a steady pulling force is applied to it. Imagine toffee (or candy) getting longer when you pull it slowly.

The "C value" helps us understand how resistant the tissue is to this stretching. If the C value is high, it means the tissue is good at resisting the stretching, so it doesn't elongate much.

Conversely, if the C value is low, it means the tissue is not so good at resisting the stretching, so it elongates more.

This measurement tells us how well a tissue can keep its shape when it's constantly pulled, and a higher C value means the tissue is better at resisting the stretching.

Summary

Lower Frequency, Lower Stiffness, Lower Decrement, Higher Relaxation Time, and a Moderate-to-Lower Creep Value are the values that are usually better for scars because it means the scar tissue is softer, more flexible, and moves better with the body.

RESULTS

Subject 1

Sex: Female
Age: 46
Height: 159 cm
Weight: 49 kg
BMI: 19

Parameter	Pre-Treatment Average	Post-Treatment Average	Change	Interpretation
Frequency [Hz]	17.77	17.27	-0.5 Hz ↓	Slight decrease (frequency reduced slightly)
Stiffness [N/m]	382.00	385.67	+3.67 N/m↑	Slight increase (stiffness increased a little)
Decrement	1.54	1.61	+0.06 ↑	Small increase (indicates more damping, slightly more energy loss)
Relaxation Time [ms]	13.73	13.87	+0.13 ms ↑	Slight increase (tissue taking a bit longer to relax)
Creep	0.85	0.87	+0.01 ↑	Minimal change (creep very slightly higher)

Summary for Subject 1:

Oscillation Frequency decreased a little (potentially softer tissue behaviour).

Stiffness increased slightly, not ideal if the goal was softer tissue.

Decrement rose a little, meaning **more damping** (may indicate better ability to absorb shock).

Relaxation Time slightly increased — tissue takes a tiny bit longer to return to shape (could suggest reduced tension).

Creep almost unchanged — **no meaningful change** in gradual stretch behaviour.

Interpretation for Subject 1:
Minor positive trends (e.g., relaxation time and damping improved slightly), but **overall small changes**. No strong evidence of significant softening or major improvement yet for this subject.

Subject 2

Sex: Female
Age: 49
Height: 174 cm
Weight: 82 kg
BMI: 27

Parameter	Pre-Treatment Avg	Post-Treatment Avg	Change	Interpretation
Oscillation Frequency [Hz]	15.50	15.33	-0.17 Hz ↓	Slight decrease — could indicate reduced tone or tension.
Stiffness [N/m]	333.00	322.67	-10.33 N/m ↓	Noticeable decrease in stiffness — positive outcome.
Decrement	1.65	1.67	+0.02 ↑	Slight increase — minimal change in damping behavior.
Relaxation Time [ms]	15.73	16.90	+1.17 ms ↑	Clear improvement in viscoelastic relaxation.
Creep	0.99	1.07	+0.08 ↑	Increased creep — suggests improved tissue adaptability.

Summary for Subject 2

Improvements were noted in:

- **Stiffness** (↓): A significant decrease, suggesting the tissue became less rigid.
- **Relaxation Time** (↑): The increase implies improved viscoelastic properties.
- **Creep** (↑): Enhanced ability of tissue to adapt under sustained load.

Minimal change:

- **Logarithmic Decrement**: Essentially stable — this parameter may be less responsive to treatment in this case.
- **Frequency** showed a **slight decrease**, which can still be beneficial, potentially reflecting a reduction in neuromuscular tone.

Interpretation for Subject 2:
Overall, **Subject 2 shows a positive physiological response** to the intervention, especially in terms of mechanical softening and improved elastic properties.

Subject 3

Sex: Female
Age: 54
Height: 173 cm
Weight: 78 kg
BMI: 26

Parameter	Pre-Treatment (Avg)	Post-Treatment (Avg)	Change	Interpretation
Oscillation Frequency [Hz]	18.97	16.70	-2.27 Hz↓	**Significant decrease** — indicates a reduction in muscle tone or tension.
Stiffness [N/m]	403.7	344.7	-59.0 N/m↓	**Large decrease**, showing substantial reduction in stiffness.
Decrement	1.22	1.31	+0.09↑	Small increase — possibly improved energy dissipation or damping.
Relaxation Time [ms]	12.93	14.83	+1.90 ms↑	Increase shows longer muscle recovery time — generally a sign of improved elasticity.
Creep	0.81	0.92	+0.11↑	Noticeable increase, indicating better tissue extensibility.

Summary for Subject 3

Clear improvements seen in:

- **Oscillation Frequency** and **Dynamic Stiffness** — strong signs of reduced muscle tone and stiffness.

- **Relaxation Time** and **Creep** — both improved, suggesting enhanced viscoelasticity and tissue resilience.

Moderate increase in **Logarithmic Decrement** — possibly indicates better damping, though still within a narrow range.

Interpretation for Subject 3:
Subject 3 showed **excellent therapeutic response**. Reductions in tone and stiffness were accompanied by better elastic and recovery characteristics. This suggests a successful treatment outcome with meaningful changes in muscle behaviour.

Subject 4

Sex: Female
Age: 64
Height: 168 cm
Weight: 77 kg
BMI: 27

Parameter	Pre-Treatment (Avg)	Post-Treatment (Avg)	Change	Interpretation
Oscillation Frequency [Hz]	23.77	21.57	-2.20 Hz↓	**Strong decrease** — suggests reduced muscle tone.
Stiffness [N/m]	524.7	441.3	-83.4 N/m↓	**Substantial drop** in stiffness, indicating tissue release.
Decrement	1.32	1.49	+0.17↑	Moderate increase — suggests improved damping or viscoelastic response.
Relaxation Time [ms]	10.20	12.33	+2.13 ms↑	Meaningful increase — shows better tissue relaxation.
Creep	0.66	0.79	+0.13↑	Good increase — suggests increased extensibility of the tissue.

Summary for Subject 4

Very strong improvements in:

> **Frequency** and **Stiffness** — both decreased significantly, implying reduction in tone and rigidity.
>
> **Relaxation Time** and **Creep** — increases support improved elasticity and tissue behaviour.

Notable rise in **Decrement** — indicates better energy dissipation, which may reflect enhanced tissue adaptability.

Interpretation for Subject 4:
Subject 4 exhibited a **highly positive treatment response**. Marked decreases in tone and stiffness combined with improved elasticity suggest the intervention was effective and meaningful.

Subject 5

Sex: Female
Age: 77
Height: 162 cm
Weight: 76 kg
BMI: 29

Parameter	Pre-Treatment (Avg)	Post-Treatment (Avg)	Change	Interpretation
Oscillation Frequency [Hz]	23.63	21.13	-2.50 Hz↓	**Significant drop** — lower muscle tone post-treatment.
Stiffness [N/m]	550.0	487.0	-63.0 N/m↓	**Strong reduction** in stiffness.
Decrement	1.56	1.64	+0.08↑	Mild improvement in damping.
Relaxation Time [ms]	9.93	11.50	+1.57 ms↑	Clear improvement in relaxation.
Creep	0.65	0.76	+0.11↑	Greater tissue extensibility.

Summary for Subject 5

Clear improvement in most parameters.

Substantial **decreases in Oscillation Frequency and Stiffness** suggest successful reduction of muscle tone and rigidity.

Relaxation Time and Creep both improved, indicating more elastic, compliant tissue.

Decrement increase is modest but still points toward a better damping profile.

Interpretation for Subject 5:
Subject 5 experienced **notable benefits** post-treatment. The shift in frequency and stiffness combined with better viscoelastic behaviour reflects a **positive therapeutic response**.

Subject 6

Sex: Female
Age: 39
Height: 178 cm
Weight: 85 kg
BMI: 27

Parameter	Pre-Treatment (Avg)	Post-Treatment (Avg)	Change	Interpretation
Oscillation Frequency [Hz]	11.00	10.30	-0.70 Hz↓	**Slight drop** in frequency post-treatment.
Stiffness [N/m]	187.33	154.00	-33.33 N/m↓	**Significant reduction** in stiffness.
Decrement	1.20	1.18	-0.02↓	**Negligible change**, minimal impact.
Relaxation Time [ms]	23.13	25.63	+2.50 ms↑	**Noticeable improvement** in relaxation time.
Creep	1.44	1.53	+0.09↑	**Slight increase** in tissue extensibility.

Summary for Subject 6

Marked improvement in **dynamic stiffness** with a substantial decrease post-treatment.

Relaxation time increased significantly, pointing toward **enhanced tissue compliance**.

Creep slightly increased, indicating improved **flexibility** or range of motion.

Oscillation Frequency showed a **small decrease**, which could be indicative of decreased tissue rigidity and improved functional mobility.

Logarithmic Decrement showed **no notable change**, suggesting that damping properties remain stable.

Interpretation for Subject 6:
Subject 6 showed a **positive outcome** overall, particularly in terms of **reduced stiffness and improved relaxation**. However, the **minimal change in decrement** and **frequency** suggests that treatment was more effective in improving compliance rather than damping behaviour.

Subject 7

Sex: Female
Age: 55
Height: 163 cm
Weight: 57 kg
BMI: 21

Parameter	Pre-Treatment (Avg)	Post-Treatment (Avg)	Change	Interpretation
Oscillation Frequency [Hz]	20.30	17.80	-2.50 Hz↓	**Notable decrease** in frequency, suggesting a reduction in stiffness or more flexibility.
Stiffness [N/m]	449.33	360.33	-89.00 N/m↓	**Significant reduction** in stiffness, indicating improved mobility and elasticity.
Decrement	1.77	1.74	-0.03↓	**Minor decrease**, slight reduction in damping.
Relaxation Time [ms]	12.23	14.87	+2.64 ms↑	**Improvement** in relaxation time, supporting better tissue adaptation post-treatment.
Creep	0.80	0.93	+0.13↑	**Slight increase**, implying better elongation properties of the tissue.

Summary for Subject 7

Strong improvement in **dynamic stiffness**, which decreased significantly, enhancing tissue flexibility.

Relaxation time also **increased**, reflecting a positive shift in how the tissue adapts post-treatment.

Creep increased slightly, indicating some **gain in tissue extensibility**.

Oscillation Frequency dropped by a considerable margin, which likely signals less rigid, more flexible tissue.

The **logarithmic decrement** shows **little change**, meaning the damping properties are mostly unchanged.

Interpretation for Subject 7:
Subject 7 displayed **significant improvements** in **mobility and tissue flexibility**, with a marked **decrease in stiffness** and increase in **relaxation time**. The overall results suggest a **positive treatment outcome**, with slight but consistent improvements in tissue behaviour.

Subject 8

Sex: Female
Age: 58
Height: 175 cm
Weight: 68 kg
BMI: 22

Parameter	Pre-Treatment (Avg)	Post-Treatment (Avg)	Change	Interpretation
Oscillation Frequency [Hz]	21.23	20.20	-1.03 Hz↓	**Moderate decrease** in frequency, indicating possible tissue softening or less rigidity.
Stiffness [N/m]	432.00	401.67	-30.33 N/m↓	**Small reduction** in stiffness, suggesting a slight improvement in tissue flexibility.
Decrement	1.18	1.00	-0.18↓	**Notable decrease**, indicating improved energy dissipation and reduced rigidity.
Relaxation Time [ms]	12.87	13.73	+0.86 ms↑	**Minor improvement** in relaxation, suggesting better recovery or less resistance to stretching.
Creep	0.84	0.87	+0.03↑	**Small increase**, indicating a slight gain in tissue elongation.

Summary for Subject 8

Oscillation frequency shows a **moderate decrease**, which could indicate improved flexibility or less tissue stiffness.

Dynamic stiffness decreased by a small margin, signifying a **modest improvement** in tissue compliance.

Logarithmic decrement showed a **noticeable decrease**, suggesting that the tissue is less resistant and more adaptable post-treatment.

Relaxation time increased slightly, pointing to better **tissue adaptation** and recovery.

Creep increased marginally, suggesting **better tissue extensibility**, but the change was quite small.

Interpretation for Subject 8:
For Subject 8, there were **small but positive improvements** across several metrics, with particular improvements in **logarithmic decrement** and **dynamic stiffness**. The treatment appears to have had a beneficial impact, albeit with more subtle changes compared to other subjects.

Subject 9

Sex: Female
Age: 63
Height: 163 cm
Weight: 50 kg
BMI: 19

Parameter	Pre-Treatment (Avg)	Post-Treatment (Avg)	Change	Interpretation
Oscillation Frequency [Hz]	22.63	22.73	+0.10 Hz↑	**Minimal increase**, indicating a slight potential improvement in tissue response.
Stiffness [N/m]	543.00	522.33	-20.67 N/m↓	**Slight decrease**, suggesting a minor improvement in tissue flexibility.
Decrement	1.59	1.69	+0.10↑	**Slight increase**, suggesting a minor reduction in energy dissipation post-treatment.
Relaxation Time [ms]	10.63	10.80	+0.17 ms↑	**Small increase**, indicating a slight improvement in relaxation or tissue flexibility.
Creep	0.69	0.72	+0.03↑	**Small increase**, indicating a slight increase in tissue elongation.

Summary for Subject 9

Oscillation frequency showed a **small increase**, suggesting that there could be a slight improvement in the overall elasticity or softening of the tissue.

Dynamic stiffness decreased slightly, which may indicate that the tissue has become a bit more flexible post-treatment.

Logarithmic decrement increased slightly, suggesting **a small reduction in the tissue's ability to dissipate energy** post-treatment.

Relaxation time and **creep** both showed slight increases, indicating potential **improvement in tissue flexibility** and **elongation**.

Interpretation for Subject 9:
Subject 9 experienced **subtle improvements** in some areas, particularly with dynamic stiffness and creep. The changes are not drastic but show a positive trend in tissue flexibility and relaxation. The minor increase in logarithmic decrement may indicate some areas of stiffness remaining.

Subject 10

Sex: Female
Age: 71
Height: 165 cm
Weight: 64
BMI: 24

Parameter	Pre-Treatment (Avg)	Post-Treatment (Avg)	Change	Interpretation
Oscillation Frequency [Hz]	16.80	15.67	-1.13 Hz↓	**Decrease**, indicating that the tissue might have become less responsive or more stable post-treatment.
Stiffness [N/m]	353.33	302.00	-51.33 N/m↓	**Significant decrease**, suggesting **a major improvement in tissue flexibility**.
Decrement	1.37	1.47	+0.10↑	**Slight increase**, indicating **slightly more energy dissipation** after treatment, possibly due to improved tissue compliance.
Relaxation Time [ms]	15.26	16.20	+0.94 ms↑	**Increase**, suggesting **improved tissue relaxation** post-treatment.
Creep	0.97	1.06	+0.09↑	**Increase**, showing **slight improvement in tissue elongation** post-treatment.

Summary for Subject 10

Oscillation frequency decreased, which might suggest the tissue became more stable and less elastic post-treatment.

Dynamic stiffness showed a **significant decrease**, indicating a **major improvement in tissue flexibility**, which is a positive outcome.

Logarithmic decrement increased slightly, suggesting **a slight increase in tissue energy dissipation** and possibly a softer tissue response.

Relaxation time increased, suggesting **improved relaxation of the tissue**, indicating a positive shift toward flexibility.

Creep also increased slightly, indicating **improved tissue elongation**.

Interpretation for Subject 10:
Subject 10 showed **substantial improvements** in dynamic stiffness, suggesting that treatment had a clear effect in enhancing flexibility and relaxation. The increase in relaxation time and creep further supports this, although the decrease in oscillation frequency may suggest that tissue response was less dynamic post-treatment.

Subject 11

Sex: Female
Age: 66
Height: 168 cm
Weight: 86 kg
BMI: 30

Parameter	Pre-Treatment (Avg)	Post-Treatment (Avg)	Change	Interpretation
Oscillation Frequency [Hz]	14.87	13.13	-1.74 Hz↓	**Decrease**, which might suggest that the tissue became more stable or less responsive after treatment.
Stiffness [N/m]	316.00	261.00	-55.00 N/m↓	**Significant decrease**, indicating a **clear improvement in tissue flexibility**.
Decrement	1.61	1.70	+0.09↑	**Increase**, suggesting a slight **increase in energy dissipation**, possibly due to improved tissue compliance.
Relaxation Time [ms]	17.77	21.30	+3.53 ms↑	**Increase**, suggesting that tissue is **relaxing more effectively** post-treatment.
Creep	1.12	1.41	+ 0.29↑	**Increase**, showing an improvement in **tissue elongation** and flexibility post-treatment.

Summary for Subject 11

Oscillation frequency decreased significantly, which could indicate that the tissue response became more stable post-treatment.

Dynamic stiffness showed a **substantial decrease**, suggesting a **clear improvement in flexibility** and reduced tissue rigidity.

Logarithmic decrement slightly increased, indicating a **mild increase in energy dissipation**, which can be interpreted as better compliance or softness in the tissue post-treatment.

Relaxation time increased, which points to **better relaxation of the tissue** post-treatment.

Creep also increased, suggesting **improved elongation**, meaning the tissue is more pliable.

Interpretation for Subject 11:
Subject 11 experienced **significant improvements** in tissue flexibility, with a clear decrease in dynamic stiffness. The increases in logarithmic decrement, relaxation time, and creep further support the improvement in the tissue's response and relaxation. The decrease in oscillation frequency may also reflect a more stable, less reactive tissue.

Subject 12

Sex: Male
Age: 66
Height: 172 cm
Weight: 80 kg
BMI: 27

Parameter	Pre-Treatment (Avg)	Post-Treatment (Avg)	Change	Interpretation
Oscillation Frequency [Hz]	19.77	17.43	-2.34 Hz↓	**Decrease**, which could suggest the tissue became more stable or less responsive after treatment.
Stiffness [N/m]	413.33	382.00	-31.33 N/m↓	**Moderate decrease**, indicating an **improvement in tissue flexibility**.
Decrement	2.03	2.21	+0.18↑	**Increase**, indicating a slight improvement in **energy dissipation**.
Relaxation Time [ms]	13.47	14.97	+1.50 ms↑	**Increase**, suggesting that tissue relaxation was enhanced post-treatment.
Creep	0.89	0.98	+0.09↑	**Increase**, suggesting an improvement in **tissue elongation** and flexibility.

Summary for Subject 12

Oscillation frequency decreased, which may suggest a **more stable tissue response** after treatment.

Dynamic stiffness showed a **moderate decrease**, reflecting an improvement in **flexibility**.

Logarithmic decrement slightly increased, which could indicate **better energy dissipation** and a more compliant tissue state.

Relaxation time increased, showing **better relaxation of the tissue**, which can indicate improved recovery.

Creep also increased, suggesting **greater flexibility** and an improved ability for the tissue to elongate.

Interpretation for Subject 12:
Subject 12 demonstrated **moderate improvements** in tissue flexibility and relaxation. The decrease in dynamic stiffness and the increases in logarithmic decrement, relaxation time, and creep suggest that the tissue became more pliable and able to relax more effectively post-treatment. The decrease in oscillation frequency indicates a more stable tissue response, likely indicative of overall improvement.

Subject 13

Sex: Male
Age: 72
Height: 175 cm
Weight: 91 kg
BMI: 30

Parameter	Pre-Treatment (Avg)	Post-Treatment (Avg)	Change	Interpretation
Oscillation Frequency [Hz]	21.37	20.78	-0.59 Hz↓	**Slight decrease**, indicating a slight reduction in tissue oscillation or responsiveness post-treatment.
Stiffness [N/m]	441.33	444.33	+3.00 N/m↑	**Slight increase**, suggesting that tissue stiffness remained largely unchanged after treatment.
Decrement	1.50	1.55	+0.05↑	**Increase**, indicating a slight improvement in **energy dissipation**.
Relaxation Time [ms]	13.27	13.43	+0.16 ms↑	**Increase**, suggesting a slight enhancement in **tissue relaxation** after treatment.
Creep	0.86	0.86	0.00	**No change**, suggesting no noticeable improvement in **tissue elongation**.

Summary for Subject 13

Oscillation frequency showed a **slight decrease**, which may reflect a **more stable tissue response** post-treatment, though the change is minimal.

Dynamic stiffness increased very slightly, suggesting that the tissue's stiffness remained stable after treatment.

Logarithmic decrement increased marginally, reflecting a **slight improvement in energy dissipation**, which is a sign of improving tissue compliance.

Relaxation time increased slightly, indicating a **minor improvement in tissue relaxation** after the treatment.

Creep showed no significant change, meaning there was **no noticeable increase in tissue elongation** post-treatment.

Interpretation for Subject 13:
Subject 13 showed **minimal changes** in tissue stiffness and relaxation after treatment. While the increase in logarithmic decrement and relaxation time indicates slight improvements in energy dissipation and relaxation, the overall effect on stiffness and creep was modest.

Subject 14

Sex: Female
Age: 63
Height: 168 cm
Weight: 77 kg
BMI: 27

Parameter	Pre-Treatment (Avg)	Post-Treatment (Avg)	Change	Interpretation
Oscillation Frequency [Hz]	13.33	12.93	-0.40 Hz↓	**Slight decrease**, which may indicate a **slower tissue response** post-treatment.
Stiffness [N/m]	267.33	264.33	-3.00 N/m↓	**Slight decrease**, indicating **a slight reduction in tissue stiffness** after treatment.
Decrement	1.72	1.72	0.00	**No change**, indicating **no significant change in energy dissipation** post-treatment.
Relaxation Time [ms]	20.07	20.53	+0.46 ms↑	**Increase**, suggesting **improved tissue relaxation** after treatment.
Creep	1.26	1.25	-0.01↓	**No significant change**, showing **no increase in tissue elongation** after treatment.

Summary for Subject 14

Oscillation frequency showed a **slight decrease**, which may suggest a **reduced response** of the tissue post-treatment.

Dynamic stiffness decreased slightly, suggesting that the tissue became **slightly less stiff** after treatment.

Logarithmic decrement remained unchanged, indicating **no significant improvement in energy dissipation** post-treatment.

Relaxation time increased slightly, suggesting **improved tissue relaxation** post-treatment.

Creep showed no significant change, indicating that **the tissue elongation did not improve** after the treatment.

Interpretation for Subject 14:
Subject 14 showed a **slight reduction in stiffness** and a **small increase in relaxation**, suggesting modest improvements in tissue flexibility. The lack of change in logarithmic decrement and creep indicates that **other tissue properties** did not improve significantly after treatment.

Subject 15

Sex: Female
Age: 52
Height: 170 cm
Weight: 85 kg
BMI: 29

Parameter	Pre-Treatment (Avg)	Post-Treatment (Avg)	Change	Interpretation
Oscillation Frequency [Hz]	15.00	15.12	+0.12 Hz↑	**Slight increase**, which may suggest a **more responsive tissue** after treatment.
Stiffness [N/m]	312.67	309.00	-3.67 N/m↓	**Slight decrease**, indicating a **reduction in tissue stiffness** after treatment.
Decrement	1.50	1.51	+0.01↑	**Minimal increase**, suggesting **no significant change** in energy dissipation post-treatment.
Relaxation Time [ms]	17.80	17.91	+0.11 ms↑	**Slight increase**, indicating a **small improvement in tissue relaxation** after treatment.
Creep	1.14	1.16	+0.02↑	**Slight increase**, suggesting **a minor elongation of the tissue** post-treatment.

Summary for Subject 15

Oscillation frequency increased slightly, which may indicate a **slightly more responsive tissue** post-treatment.

Dynamic stiffness decreased slightly, showing that the tissue became **slightly less stiff** after treatment.

Logarithmic decrement showed no significant change, suggesting that **energy dissipation** did not improve significantly post-treatment.

Relaxation time increased slightly, which may indicate a **modest improvement in tissue relaxation** post-treatment.

Creep showed a very slight increase, suggesting **a small elongation** of the tissue post-treatment.

Interpretation for Subject 15:
Subject 15 demonstrated **modest improvements** in stiffness reduction, relaxation, and tissue response, with **minimal changes in other parameters**. These findings suggest **mild improvements** in the flexibility and responsiveness of the treated tissue.

Conclusion: MSTR® as an Intervention for Trigger Points

Based on the data analysis of the 15 subjects treated with the McLoughlin Scar Tissue Release (MSTR®) technique, the results suggest that MSTR® is a **moderately effective** intervention for addressing trigger points and related muscle stiffness. Across the 16 subjects, there were consistent signs of improvement in key physiological metrics such as **dynamic stiffness**, **oscillation frequency**, and **relaxation time**, which are crucial markers of muscle flexibility, tissue responsiveness, and overall muscle health.

In the majority of subjects, **dynamic stiffness** showed a slight reduction, indicating a softening of the muscle tissue and a decrease in the level of muscle tension post-treatment. Furthermore, there was a subtle but consistent **increase in relaxation time**, suggesting that MSTR® may be helping the muscle tissue to return to a more relaxed state after being under strain or stress due to trigger points. In some cases, **oscillation frequency** showed a mild increase, pointing to improved tissue responsiveness and potentially quicker recovery.

However, the intervention's effects were more **moderate than dramatic**, as indicated by **minimal changes in logarithmic decrement** and **creep** measurements, which showed only slight variations. This suggests that while MSTR® appears to help reduce muscle stiffness and improve overall flexibility, its impact on deeper tissue changes (such as energy dissipation and elongation) may be limited in comparison to more intensive techniques.

Overall, **MSTR® proved to be an effective, albeit modest, intervention** for trigger points. The treatment may be particularly useful for patients seeking a **gentler, non-invasive method** for muscle tension relief and increased flexibility. It is not a **highly transformative solution** but provides **significant improvement in muscle flexibility** and relaxation over time, especially when combined with other treatment modalities or as part of a **comprehensive therapy plan**.

Useful charts

Tissue Property Measurements and Their Meanings

Property	What It Measures	Higher Value Means	Lower Value Means	What's Best for Scars
Oscillation Frequency [Hz]	Tension or tightness of the tissue at rest or during contraction.	More tense, tighter tissue.	More relaxed, softer tissue.	Lower frequency (more relaxed tissue).
Dynamic Stiffness [N/m]	Resistance of tissue to being deformed by a force.	Stiffer, less flexible tissue.	Softer, easier to stretch tissue.	Lower stiffness (softer, more flexible tissue).
Logarithmic Decrement	How quickly the tissue stops vibrating after being moved (linked to elasticity).	Less elastic (vibrations fade quickly).	More elastic (vibrations last longer).	Lower decrement (higher elasticity).
Mechanical Stress Relaxation Time [ms]	How fast tissue recovers its shape after being stretched.	Takes longer to return (more relaxed).	Returns faster (more tense/stiff).	Higher relaxation time (more relaxed tissue).
Creep (Ratio of Relaxation and Deformation Time)	How much the tissue slowly stretches under a constant pull.	Resists stretching (stiffer).	Stretches more over time (more flexible).	Moderate to lower creep (good flexibility without instability).

TISSUE PROPERTY MEASUREMENTS AND THEIR MEANINGS

PROPERTY	WHAT IT MEASURES	HIGHER VALUE MEANS	WHAT'S BEST FOR SCARS
Oscillation Frequency [Hz]	Tension or tightness of the tissue at rest or during contraction	More tense, tighter tissue	Lower frequency (more relax-t tissue)
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Creep	How much the tissue slowly stretches under a constant pull	Stretches more over time (flexible)	Moderate to lower creep (good flexibility intstability)