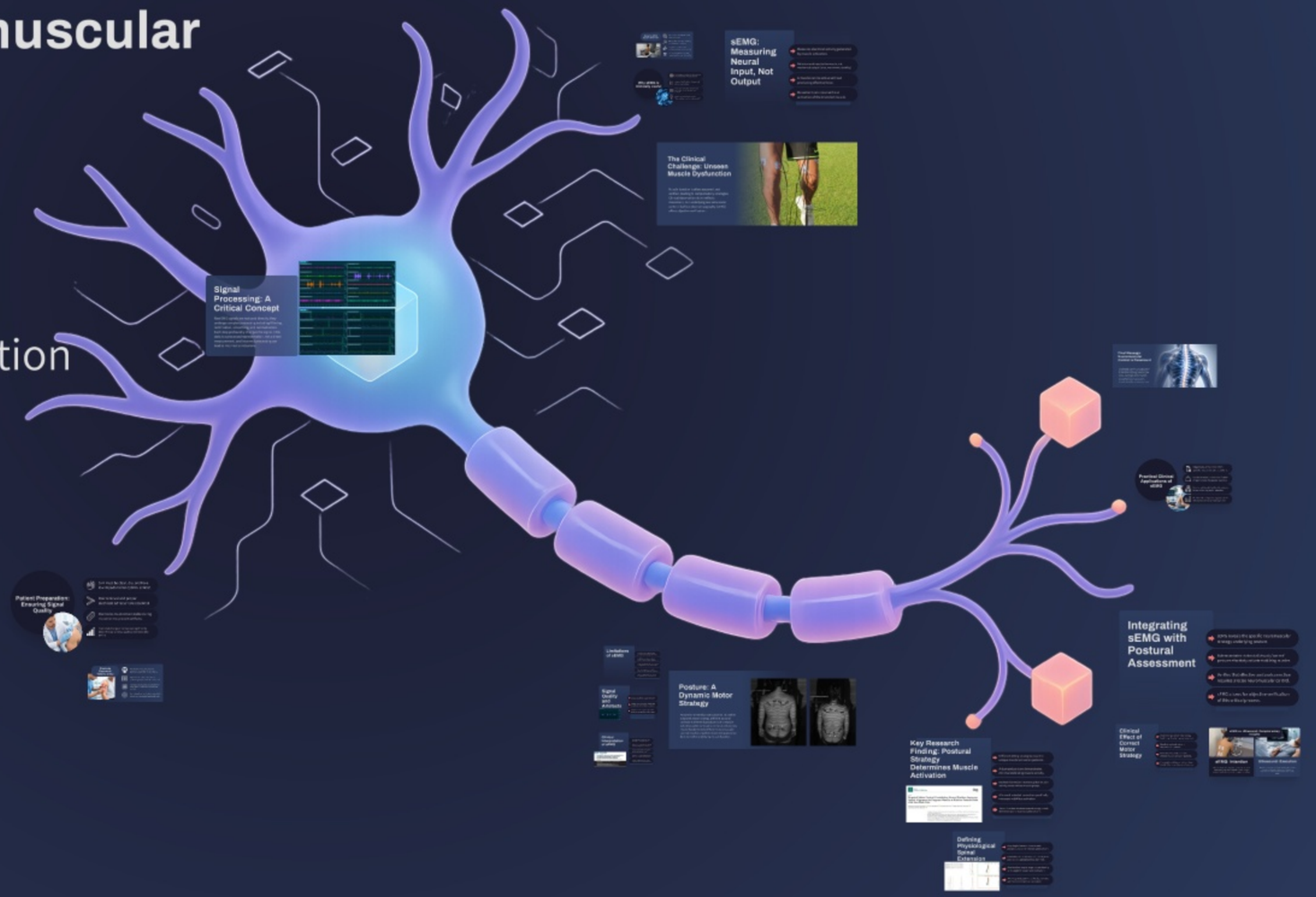
Fundusze Europejskie dla Rozwoju Społecznego
Rzeczpospolita Polska
Dofinansowane przez Unię Europejską
NAWA NARODOWA AGENCJA WYMIANY AKADEMICKIEJ

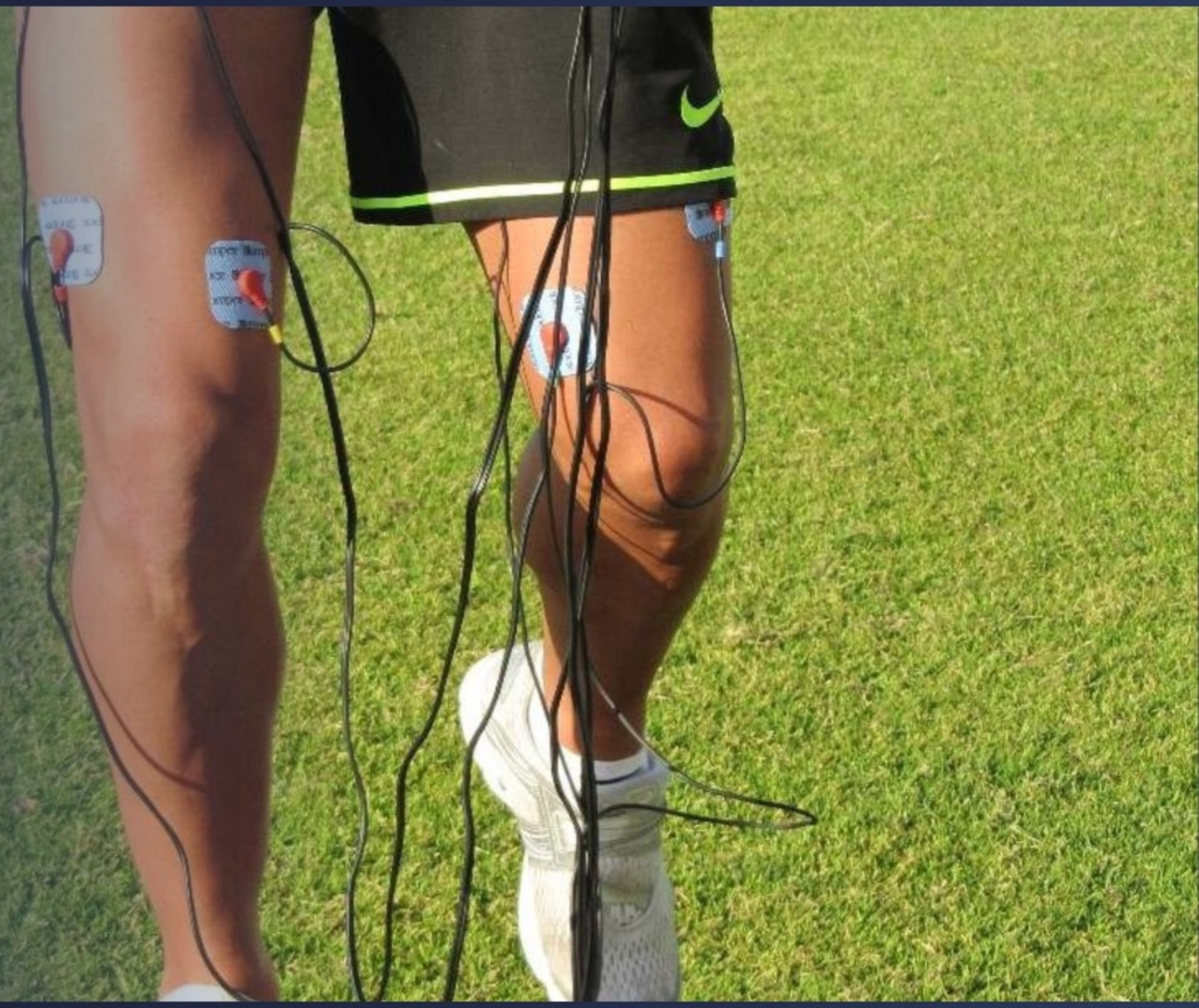
Understanding sEMG for Neuromuscular Assessment

Beyond Observation: Verifying Muscle Function and Postural Strategies



The Clinical Challenge: Unseen Muscle Dysfunction

Muscle function is often assumed, not verified, leading to compensatory strategies. Clinical observation alone reflects movement, not underlying neuromuscular control. Surface electromyography (sEMG) offers objective verification.



sEMG: Measuring Neural Input, Not Output

- Measures electrical activity generated by muscle activation.
- Reflects neural input to the muscle, not mechanical output (force, movement, stability).
- A muscle can be active without producing effective force.
- Movement can occur without activation of the intended muscle.

Why sEMG is Clinically Useful

- Provides precise information about timing and coordination of muscle activation.
- Allows identification of onset and duration of activity.
- Reveals coordination patterns between muscles, which is often more clinically relevant than amplitude.
- Answers the fundamental question: 'When and how does the muscle activate?'

Noraxon sEMG System Overview

Surface electrodes detect muscle electrical activity.

The signal is transmitted wirelessly and processed in real time.

Multiple muscles can be recorded simultaneously for comprehensive analysis.

The system provides raw data; clinical meaning depends on expert interpretation.

Signal Processing: A Critical Concept

Raw EMG signals are not used directly; they undergo complex processing including filtering, rectification, smoothing, and normalization. Each step profoundly changes the signal. EMG data is a processed representation, not a direct measurement, and incorrect processing can lead to incorrect conclusions.

Patient Preparation: Ensuring Signal Quality

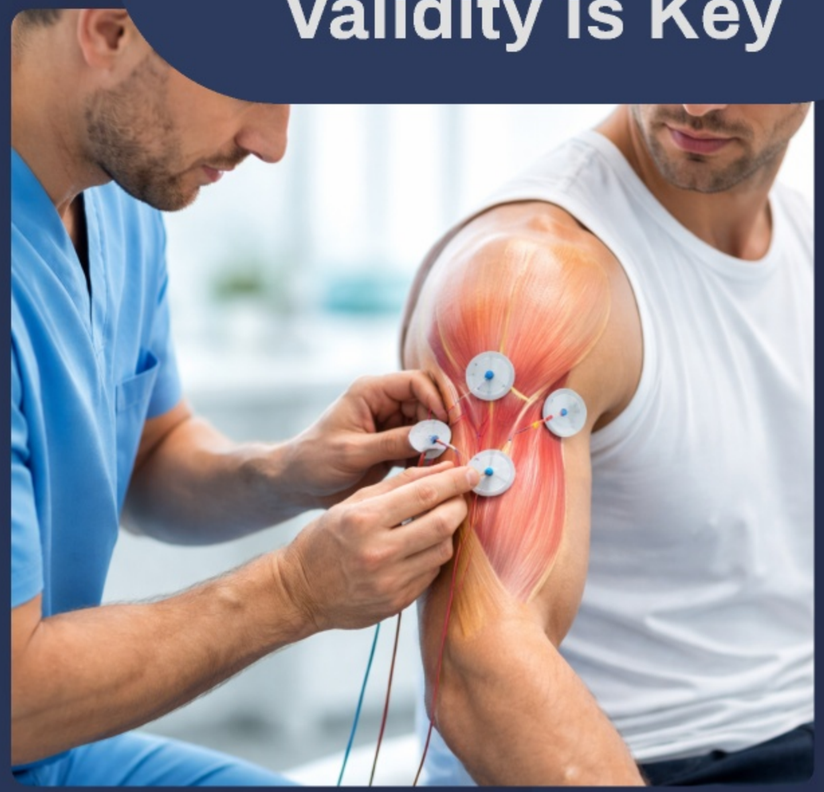
Skin must be clean, dry, and have low impedance for optimal contact.

Hair removal and proper electrode adhesion are essential.

Electrodes must remain stable during movement to prevent artifacts.

Even small changes in contact can significantly distort the signal. Setup quality determines data quality.

Electrode Placement: Validity is Key



Electrodes must be placed precisely over the muscle belly.

Alignment with fiber direction and positioning away from tendons are crucial.

Incorrect placement can lead to recording from the wrong muscle or significant crosstalk, reducing specificity.

Accurate placement is fundamental to obtaining meaningful and valid data.

Signal Quality and Artefacts

- A valid EMG signal exhibits low baseline noise, a clear increase during contraction, and a stable waveform.
- Artefacts, such as movement of electrodes or cables, can mimic true muscle activity.
- All signals must be rigorously verified before any interpretation can be made.

Limitations of sEMG

- Crosstalk limits muscle specificity, particularly for assessing deep muscles.
- Amplitude alone does not directly equate to muscle function or efficiency.
- A higher signal might reflect compensatory strategies rather than efficient movement.
- Results are highly dependent on meticulous methodology and individual anatomical variations.
- sEMG requires careful and cautious interpretation in a clinical context.

Clinical Interpretation of sEMG

fizjoterapia polska

nr 3/2017 (17)

Ocena sEMG aktywności mięśnia prostego brzucha oraz mięśnia wielodzielnego w zależności od sposobu przyjmowania pozycji siedzącej

sEMG assessment of the activity of the rectus abdominis and multifidus muscles in different sitting postures

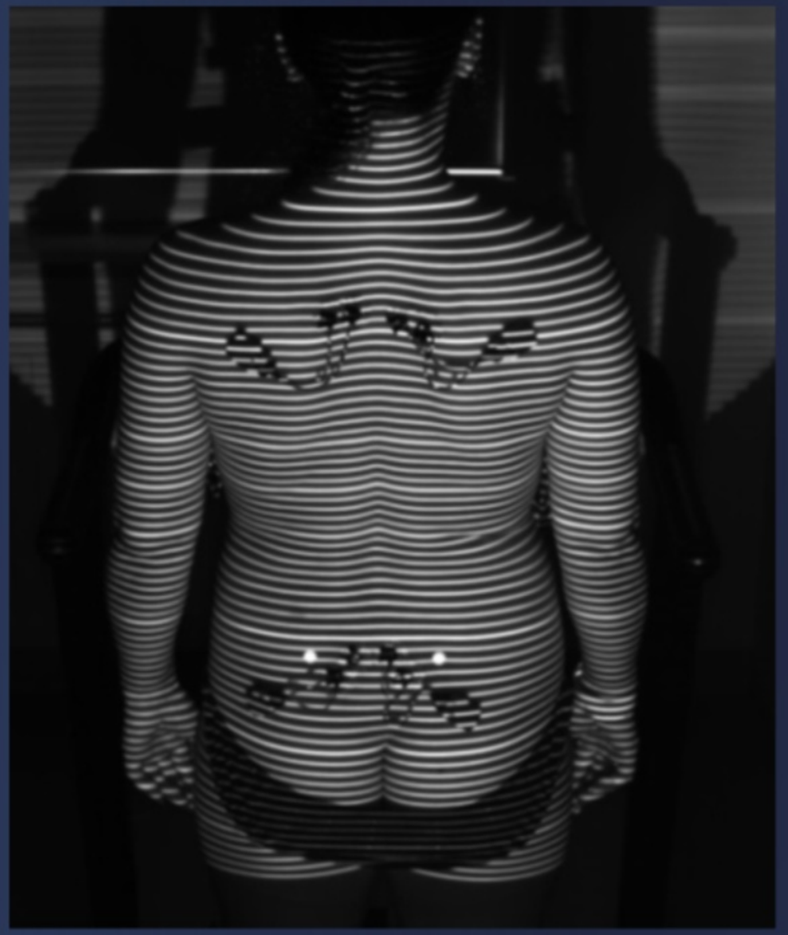
Wojciech Kiebzak[1,2(A,B,C,D,E,F,G)], Michał Dwornik[3(B,D,E,F,G)], Justyna Żurawska[1(D,E,F)], Arkadiusz Żurawski[1,2(B,C,D,E,F)]

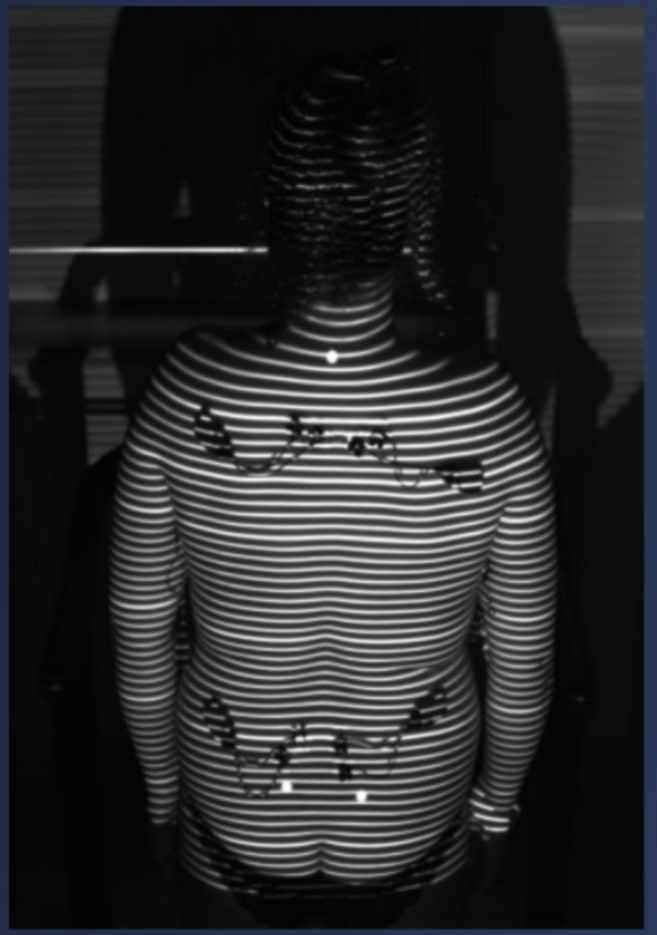
[1]Uniwersytet Jana Kochanowskiego w Kielcach, Wydział Lekarski i Nauk o Zdrowiu, Kielce, Polska/
Department of Physiotherapy, Faculty of Medicine and Health Sciences, Jan Kochanowski University, Kielce, Poland
[2]Świętokrzyskie Centrum Pediatrii w Kielcach, Dział Fizjoterapii, Kielce, Polska/
Swiętokrzyski Pediatric Center in Kielce, Department of Physiotherapy, Kielce, Poland
[3]Wyższa Szkoła Medyczna w Podkowie Leśnej, Wydział Medycyny Osteopatycznej i Fizjoterapii , Podkowa Leśna, Polska/
Department of Physiotherapy and Department of Osteopathic Medicine, Medical College of Podkowa Leśna, Poland

- Interpret patterns of activation and deactivation, not isolated values.
- Timing and coordination of muscle activation are often more important than amplitude.
- Delayed or absent activation patterns typically indicate dysfunction.
- Amplitude must always be interpreted within its specific clinical context and patient presentation.
- sEMG data must be integrated with thorough clinical reasoning and other assessment findings.

Posture: A Dynamic Motor Strategy

Posture is not merely a static position, but rather a dynamic motor strategy. Different postural corrections inherently produce distinct muscle activation patterns. Visually similar positions may involve fundamentally different neuromuscular control, emphasizing that movement appearance does not define underlying muscle function.





Key Research Finding: Postural Strategy Determines Muscle Activation

Journal of Clinical Medicine

MDPI

Article

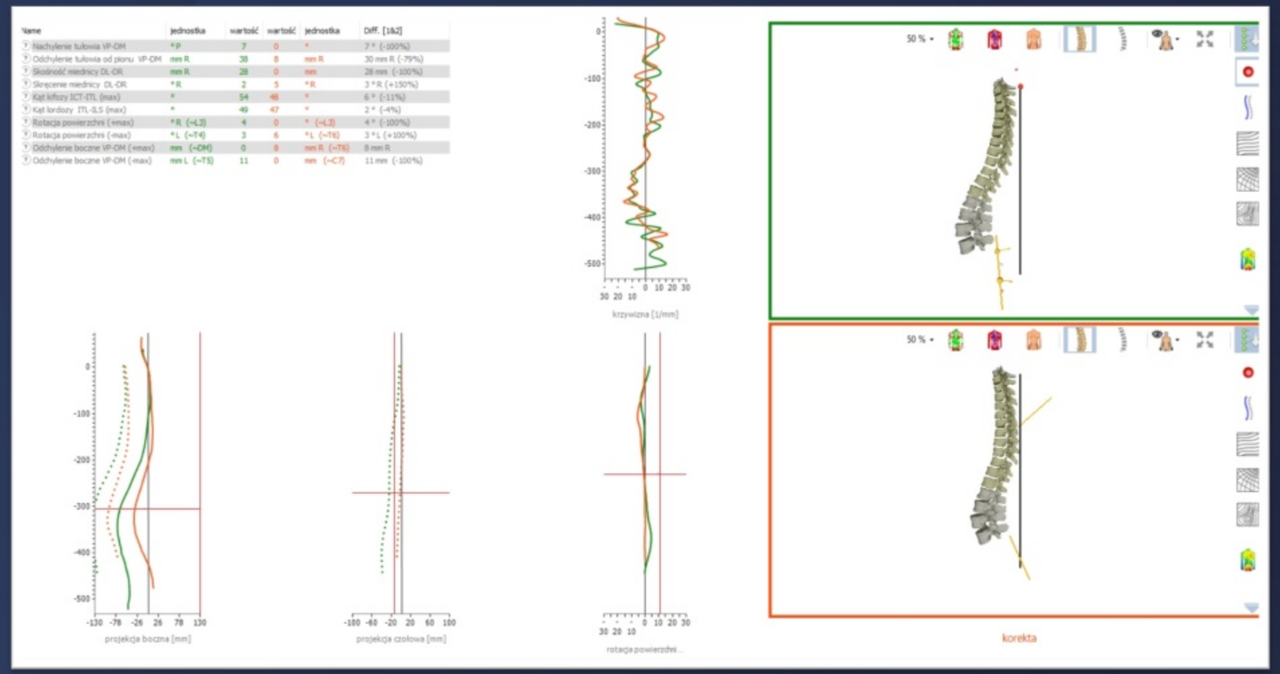
Targeted Motor Control Considering Sternal Position Improves Spinal Alignment in Pregnant Women at Risk for Preterm Birth with Low Back Pain

Arkadiusz Łukasz Żurawski [1,*], Sun Young Ha [2], Grzegorz Świercz [3], Olga Adamczyk Gruszka [3] and Wojciech Piotr Kiebzak [1]

[1] Collegium Medicum, Jan Kochanowski University in Kielce, al. IX Wieków Kielc 19a, 25-516 Kielce, Poland; wojciech.kiebzak@ujk.edu.pl
[2] Health & Wellness Research Institute, Kyungnam University, 7 Kyungnamdaehak-ro, Masanhappo-gu, Changwon-si 51767, Gyeongsangnam-do, Republic of Korea; mallows205@naver.com
[3] Clinic of Gynecology and Obstetrics, Provincial Complex Hospital, Grunwaldzka 45, 25-736 Kielce, Poland; grzegorz.swiercz60@gmail.com (G.Ś.); oadamczyk@ujk.edu.pl (O.A.G.)
* Correspondence: arkadiusz.zurawski@ujk.edu.pl; Tel.: +48-787339222

- Different sitting strategies result in unique muscle activation patterns.
- A slumped posture demonstrates minimal stabilizing muscle activity.
- Backward correction increases global muscle activity across various muscle groups.
- A forward-oriented correction specifically increases multifidus activation.
- This confirms that the chosen postural strategy directly determines specific muscle activation patterns.

Defining Physiological Spinal Extension



- Physiological extension is not a static posture, but a coordinated activation pattern.
- It includes sternum elevation, controlled pelvic position, and appropriate head alignment.
- Also involves proper scapular positioning and a slight forward trunk inclination.
- This integrated pattern specifically promotes optimal stabilizing muscle activation.

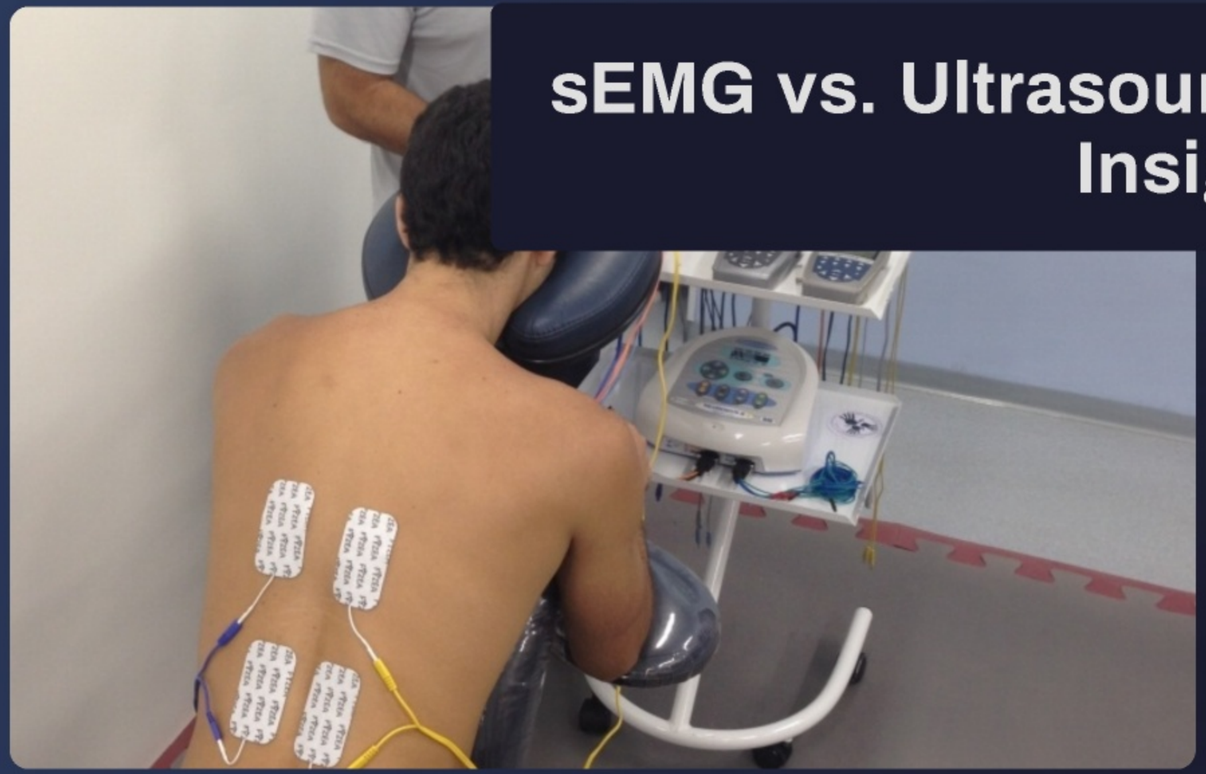
Clinical Effect of Correct Motor Strategy

- Implementing a correct motor strategy leads to significantly improved alignment.
- Results in reduced pain and discomfort for patients.
- Promotes improved and more efficient muscle activation patterns.
- Changing the underlying activation strategy directly influences positive clinical outcomes.

Integrating sEMG with Postural Assessment

- sEMG reveals the specific neuromuscular strategy underlying posture.
- It demonstrates that not all visually 'correct' postures effectively activate stabilizing muscles.
- Verifies that effective postural correction requires precise neuromuscular control.
- sEMG allows for objective verification of this critical process.

sEMG vs. Ultrasound: Complementary Insights



sEMG: Intention

Measures electrical activity, directly reflecting the neural input and the 'intention' to activate a muscle. It shows when and how the brain attempts to engage muscle fibers.

Ultrasound: Execution

Measures the mechanical response, showing actual muscle contraction, thickening, and movement. It reveals the 'execution' and mechanical effectiveness of the muscle's action.

Practical Clinical Applications of sEMG

- Objectively verify and confirm specific muscle activation patterns.
- Guide the selection and modification of appropriate therapeutic exercises.
- Provide real-time biofeedback to patients for motor learning and re-education.
- Monitor and track patient progress and the effectiveness of interventions over time.

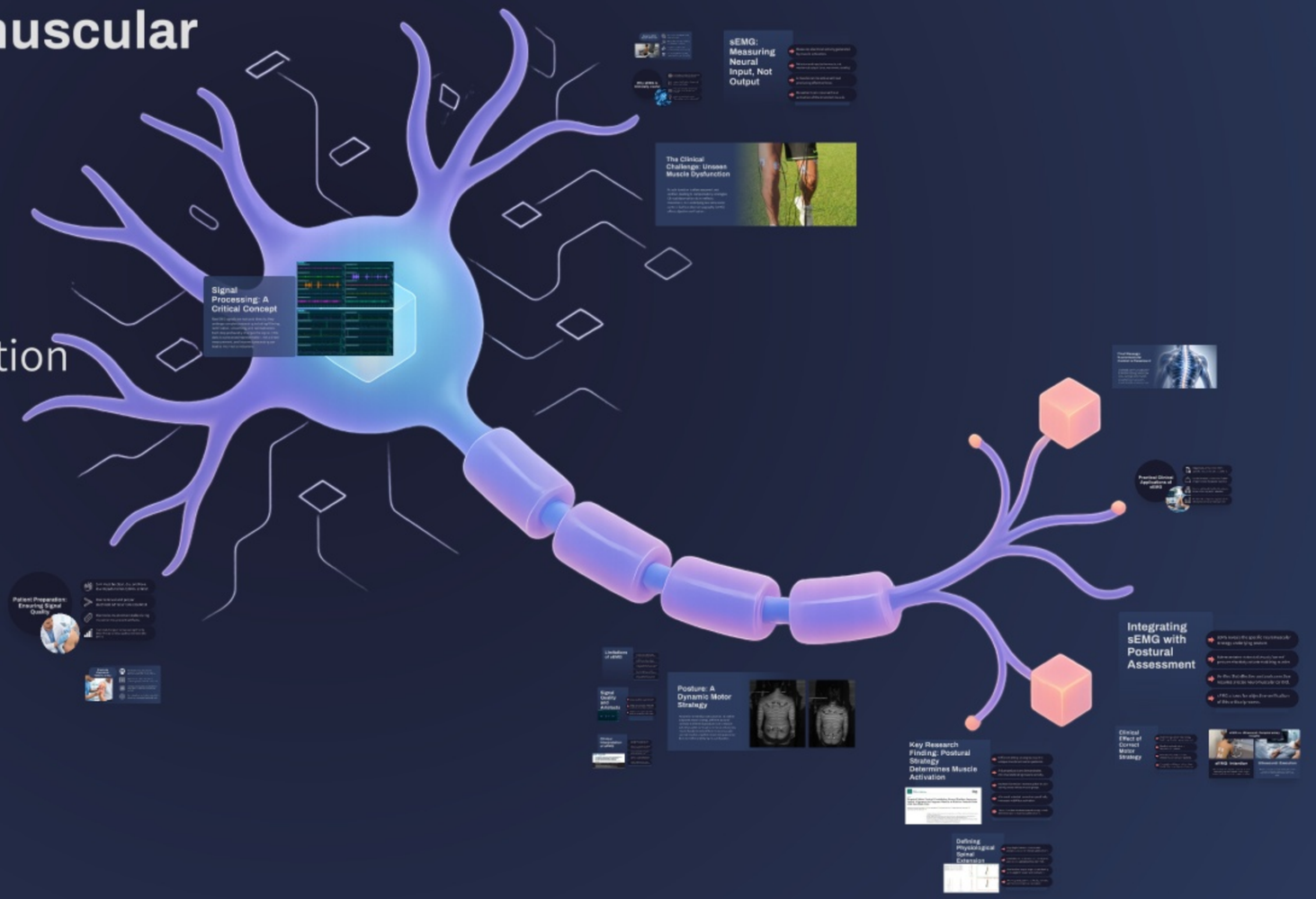
Final Message: Neuromuscular Control is Paramount

Physiological spinal extension is not simply achieved by positioning the body; it is fundamentally driven by coordinated neuromuscular control. While sEMG allows for the observation of this crucial neural activation, it demands correct setup, meticulous methodology, and informed interpretation. Ultimately, physiological spinal extension is a neuromuscular strategy, not merely a static posture.

Fundusze Europejskie dla Rozwoju Społecznego
Rzeczpospolita Polska
Dofinansowane przez Unię Europejską
NAWA NARODOWA AGENCJA WYMIANY AKADEMICKIEJ

Understanding sEMG for Neuromuscular Assessment

Beyond Observation: Verifying Muscle Function and Postural Strategies



Take this with you.
Revisit anytime.

Missed something? Want to explore further?
Scan or click below to open this presentation.
Anytime, anywhere.

View presentation