Dr. Ammar Yaseen Mansour

Clonus: 2nd Pathophysiological Hypothesis

"An endless duel of action-reaction—where each reflex fuels its enemy's retaliation"

To watch a detailed video explaining this hypothesis, click:

Clonus manifests as involuntary, rhythmic oscillations – aberrant sequential cycles of joint flexion and extension. Pathological clonus requires >5 flexion-extension cycles. While similar movements may occur in healthy individuals, they never exceed 5 cycles. When accompanied by other signs of Upper Motor Neuron (UMN) lesions, even brief clonus (<5 cycles) warrants diagnostic consideration. Clinically, we primarily investigate clonus at the knee and ankle. Though possible elsewhere, such occurrences remain exceptional.

Clonus may alternatively be conceptualized as a cascade of spatially opposed, functionally antagonistic spinal reflexes. These reflexes fire sequentially yet overlap temporally – where the termination of one reflex triggers its functional counterpart in a self-perpetuating kinetic chain. Each reflex conclusion serves as the initiator for its successor, creating a movement continuum that may persist for prolonged durations.

In Upper Motor Neuron (UMN) injuries, sudden ankle dorsiflexion elicits clonus – clinically characterized by involuntary, rhythmic ankle flexion-extension oscillations. Deconstructing this movement reveals its elemental composition: each oscillation embodies the sequential firing of two antagonistic reflexes:

1. *Achilles Reflex (Plantarflexion via S1-L5)*
2. *Tibialis Anterior Reflex (Dorsiflexion via L4-L5)*

Pathomechanics of Ankle Clonus

Initial Trigger:

*Sudden ankle **dorsiflexion** imposes axial tension on the **Achilles tendon**. This stimulates **tendon receptors** (Golgi organs) to detect abrupt structural changes, activating the pathological spinal reflex circuit.*

Phase 1: Plantarflexion Reflex

*Violently and abruptly, the target muscles (Gastrocnemius and Soleus) contract Resulting in powerful **plantarflexion**.*

Phase 2: Reciprocal Reflex Triggering

*This forceful and sudden plantarflexion **stretches the antagonistic muscle group** (tibialis anterior), activating a second pathological spinal reflex – the hyperreflexic **tibialis anterior reflex**.*

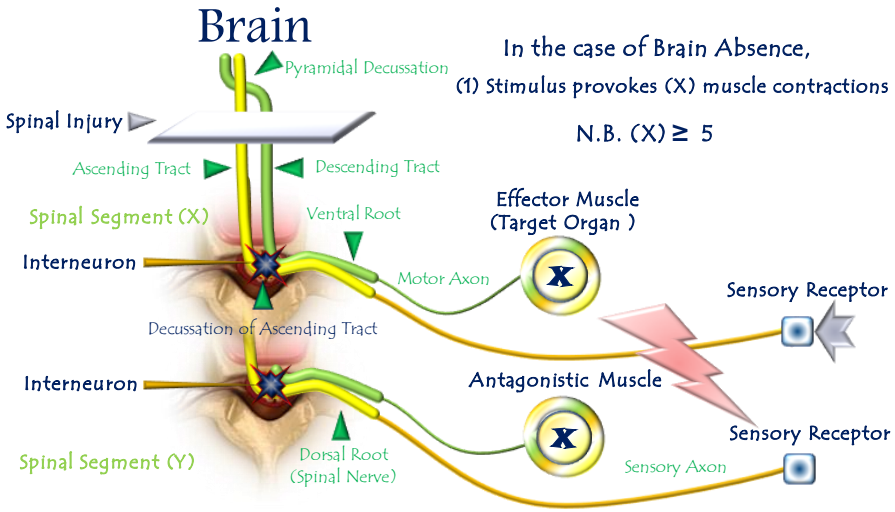
Following its own violent and sudden stretch, the Tibialis Anterior Muscle contracts with equal force and abruptness, producing forceful dorsal flexion (ankle dorsiflexion) as the kinetic counter-response. This antagonistic rebound inevitably reignites the opposing reflex cascade.

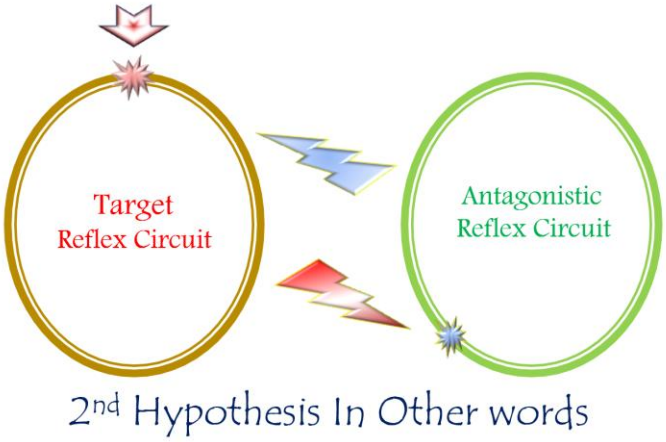
Here, both logic and function vanish – transforming movement into a self-perpetuating feud of action and counter-action. An unstoppable cascade of involuntary motions ceases only when:

1. *Muscular energy reserves deplete, OR*
2. *Spontaneous reflex decay dampens the pathological circuits.*

Terminal Phase:

The action fades... its reaction falters... until both dissolve into neurological silence. Thus concludes the combatants' ceasefire – a temporary armistice awaiting inevitable future battles. (See Figure Below).





Second Hypothesis of Clonus Pathophysiology

(The Lifecycle of Pathological Oscillations)

For video explanation, click here:

Core Mechanism: Antagonistic Reflex Warfare

An endless duel of action-reaction—where each reflex fuels its enemy's retaliation.

Key Pathological Features

Phase	*Neurophysiological Event*	*Clinical Manifestation*
Initiation	*Violent Achilles tendon stretch*	*Sudden ankle dorsiflexion*
Counterstrike 1	*Unchecked plantarflexion reflex*	*Explosive foot downward jerk*
Counterstrike 2	*Tibialis anterior stretch → Reflex contraction*	*Forceful foot upward jerk*
Perpetuation	*Cyclical re-stretching*	*Rhythmic oscillations (clonus)*
Cessation	*ATP depletion + neural fatigue*	*Self-limiting collapse (>5 beats)*

Why This Explains Clinical Clonus

1. *Rhythmicity:*
    - *Alternating agonist/antagonist firing creates stereotyped flexion-extension cycles*
2. *Ankle Predilection:*
    - *Maximal mechanical advantage between gastrocnemius (PF) and tibialis anterior (DF)*
3. *Self-Limitation:*
    - *Terminates when:*
        - *Muscles exhaust ATP reserves*
        - *LMNs enter refractory state*
        - *Reflex gain spontaneously dampens*
4. *UMN Specificity:*
    - *Requires lost reciprocal inhibition (normally mediated by UMNs)*

Contrast with Normal Physiology

Normal Reflexes	*Clonus State*
Reciprocal inhibition blocks antagonists	*Mutual excitation of enemies*
Cortical modulation grades responses	*Explosive, non-calibrated contractions*
Functionally protective	*Purposeless energy waste*

Therapeutic Targets

Goal	*Intervention*	*Mechanism*
Break the Loop	*Botulinum toxin to gastrocnemius & tibialis anterior*	*Chemodenervation of combatant muscles*
Restore Inhibition	*Intrathecal baclofen*	*GABA-B receptor agonism*
Limit Stretch	*Ankle-foot orthosis (AFO)*	*Prevents sudden dorsiflexion trigger*

Conclusion: Neurology of Reflex Combat

This hypothesis reframes clonus as:

"A futile neural war—where Achilles and tibialis anterior reflexes become locked in mutual destruction, each contraction stretching the opponent into retaliation, until biochemical exhaustion forces a temporary truce."

Clinical Imperatives:

1. *Test for >5 beats after sudden dorsiflexion*
2. *Address early (before maladaptive circuit entrenchment)*
3. *Combine chemical denervation + mechanical containment*

……

In other contexts, you can also read the following articles:

- *The Spinal Reflex, New Hypothesis of Physiology*
- *The Hyperreflexia, Innovated Pathophysiology*
- *The Spinal Shock*
- *The Spinal Injury, the Pathophysiology of the Spinal Shock, the Pathophysiology of the Hyperreflexia*
- *Upper Motor Neuron Lesions, the Pathophysiology of the Symptomatology*
- *The Hyperreflexia (1), the Pathophysiology of Hyperactivity*
- *The Hyperreflexia (2), the Pathophysiology of Bilateral Responses*
- *The Hyperreflexia (3), the Pathophysiology of Extended Hyperreflex*
- *The Hyperreflexia (4), the Pathophysiology of Multi-Response Hyperreflex*
- *The Clonus, 1st Hypothesis of Pathophysiology*
- *The Clonus, 2nd Hypothesis of Pathophysiology*
- *The Clonus, Two Hypotheses of Pathophysiology*

- *The Nerve Transmission through Neural Fiber, Personal View vs. International View*
- *The Nerve Transmission through Neural Fiber (1), The Action Pressure Waves*
- *The Nerve Transmission through Neural Fiber (2), The Action Potentials*
- *The Nerve Transmission through Neural Fiber (3), The Action Electrical Currents*
- *The Function of Standard Action Potentials & Currents*

- *The Three Phases of Nerve transmission*

- *Neural Conduction in the Synapse (Innovated)*

- *Nodes of Ranvier, the Equalizers*
- *Nodes of Ranvier, the Functions*
- *Nodes of Ranvier, First Function*
- *Nodes of Ranvier, Second Function*
- *Nodes of Ranvier, Third Function*
- *Node of Ranvier, The Anatomy*

- *The Wallerian Degeneration*
- *The Neural Regeneration*
- *The Wallerian Degeneration Attacks Motor Axons, While Avoids Sensory Axons*

- *The Sensory Receptors*

- *Nerve Conduction Study, Wrong Hypothesis is the Origin of the Misinterpretation (Innovated)*

- *Piriformis Muscle Injection_ Personal Approach*

- *The Philosophy of Pain, Pain Comes First! (Innovated)*

- *The Philosophy of the Form (Innovated)*
- *Pronator Teres Syndrome, Struthers-Like Ligament (Innovated)*
- *Ulnar Nerve, Congenital Bilateral Dislocation*
- *Posterior Interosseous Nerve Syndrome*
- *The Multiple Sclerosis: The Causative Relationship Between The Galvanic Current & Multiple Sclerosis?*
- *Cauda Equina Injury, New Surgical Approach*
- *Carpal Tunnel Syndrome Complicated by Complete Rupture of Median Nerve*
- *Biceps Femoris' Long Head Syndrome (BFLHS)*

- *Barr Body, The Whole Story (Innovated)*
- *Adam's Rib and Adam's Apple, Two Faces of one Sin*
- *Adam's Rib, could be the Original Sin?*
- *Barr Body, the Second Look*

- *Who Decides the Sex of Coming Baby?*
- *Boy or Girl, Mother Decides!*
- *Oocytogenesis*
- *Spermatogenesis*
- *This Woman Can Only Give Birth to Female Children*
- *This Woman Can Only Give Birth to Male Children*
- *This Woman Can Give Birth to Female Children More Than to Male Children*

- *This Woman Can Give Birth to Male Children More Than to Female Children*
- *This Woman Can Equally Give Birth to Male Children & to Female Children*

- *Eve Saved Human Identity; Adam Ensured Human Adaptation*

- *Coronavirus (Covid-19): After Humiliation, Is Targeting Our Genes*
- *Coronavirus (Covid-19): After Humiliation, Is Targeting Our Genes*

- *The Black Hole is a (the) Falling Star?*
- *Mitosis in Animal Cell*
- *Meiosis*

- *Universe Creation, Hypothesis of Continuous Cosmic Nebula*
- *Circulating Sweepers*

- *Pneumatic Petrous, Bilateral Temporal Hyperpneumatization*
- *Congenital Bilateral Thenar Hypoplasia*
- *Ulnar Dimelia, Mirror hand Deformity*

- *Surgical Restoration of a Smile by Grafting a Segment of the Gracilis Muscle to the Face*
- *Mandible Reconstruction Using Free Fibula Flap*

- *Presacral Schwannoma*
- *Giant Liver Hemangioma Liver Hemangioma: Urgent Surgery of Due to Intra-Tumor Bleeding*
- *Free Para Scapular Flap (FPSF) for Skin Reconstruction*
- *Claw Hand Deformity (Brand Operation)*
- *Algodystrophy Syndrome Complicated by Constricting Ring at the Proximal Border of the Edema*
- *Non- Traumatic Non- Embolic Acute Thrombosis of Radial Artery (Buerger's Disease)*
- *Isolated Axillary Tuberculosis Lymphadenitis*
- *The Iliopsoas Tendonitis... The Snapping Hip*

To read the article in Arabic, click on →

- *The New Frankenstein Monster*
- *The Lone Wolf*
- *The Delirium of Night and Day*
- *The Delirium of the Economy*
- *Ovaries in a Secure Corner… Testicles in a Humble Sac: An Inquiry into the Function of Form*
- *Eve Preserves Humanity's Blueprint; Adam Drives Its Evolution*

2/6/2020