***Dr. Ammar Yaseen Mansour***

***Pathophysiology of Clonus***

*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: 1st Pathophysiological Hypothesis  
“Asynchronous Afferent Barrage”***

*"One stretch becomes a symphony of desynchronized commands - each afferent volley demanding its own motor encore"*

*[video](https://youtu.be/ySQ7M0KPWaU)*[*To watch a detailed video explaining this hypothesis, click this link:*](https://youtu.be/ySQ7M0KPWaU)

*Within the operational field of every spinal reflex, specialized sensory receptors serve as the reflex's trigger points. Alongside them reside other sensory receptor types – all occupying the same territory where reflex-triggering stimuli occur.*

*Each receptor possesses its own dedicated neural axon. Since receptors differ functionally, their afferent axons exhibit distinct properties – particularly variable neural conduction velocities.*

*Neural transmission is maximally rapid in myelinated alpha-type axons, yet markedly slow in delta-type axons – among others. Similarly, transmission through demyelinated axons is severely delayed. Even within a single fiber type, conduction velocity varies significantly with axonal diameter.*

*This inherent disparity in conduction velocities across afferent pathways constitutes the fundamental mechanism underlying the First Hypothesis of Clonic Pathophysiology.*

*Under physiological conditions, sensory receptors (numbering X) distribute a stimulus' energy among themselves – each according to its functional specialization. Subsequently, via heterogeneous neural pathways, signals from these receptors converge as a hybrid, non-homogenous afferent impulse carrying X distinct sensory elements.*

*The brain purifies and processes this composite input. Through meticulous filtering, decoding, and integration, it distills the heterogeneous sensory stream into a singular efferent motor command – delivered to the lower motor neuron as one unified execution order.*

*When the brain becomes functionally absent, a hyperreflexic spinal circuit emerges. Sensory neurons aberrantly connect with lower motor neurons via interneurons – bypassing cortical governance.*

*The hybrid afferent impulse (comprising X distinct signals) escapes cerebral supervision. It descends unprocessed to the LMN, retaining its raw temporal dispersion from peripheral receptors.*

*The fastest-conducting impulses trigger the initial muscle contraction. The**mid-velocity signals arrive eliciting sequential contractions.**The slowest impulses drive terminal oscillations.*

*This cascade of desynchronized muscle activations manifests as involuntary movement repetition in hyperreflexic states – the phenomenon we term Clonus. (Figure 1).*

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| ***Figure 1: First Hypothesis of Clonus Pathophysiology (Temporal Dispersion → Clonic Oscillation)***  [*[video](https://youtu.be/ySQ7M0KPWaU)For video explanation, click here*:](https://youtu.be/ySQ7M0KPWaU)  ***Core Mechanism: Temporal Dispersion → Rhythmic Oscillations***  ***Normal vs. Pathological Processing***   | ***Stage*** | ***Healthy State*** | ***UMN Lesion State*** | | --- | --- | --- | | *Afferent Signal* | *Hybrid impulse (X elements)* | *Identical hybrid impulse* | | *Integration* | *Cortical processing → Unified command* | *Direct spinal relay* | | *Motor Output* | *Single calibrated response* | *X sequential responses* | | *Feedback Loop* | *Purposeful termination* | *Self-sustaining oscillations* |   ***Key Pathophysiological Steps***   1. *Stimulus Application*    * *Activates heterogeneous receptor cohort (muscle spindles, Golgi, nociceptors)* 2. *Temporal Dispersion*    * *Variable conduction velocities → Staggered afferent arrival at spinal cord* 3. *Spinal Relay Hijacking*    * *Interneurons deliver raw volleys directly to LMNs* 4. *Serial Motor Firing*    * *Fastest volley → Initial contraction (e.g., dorsiflexion)*    * *Intermediate volley → Secondary contraction*    * *Slowest volley → Tertiary contraction*   *"One stretch becomes a symphony of desynchronized commands - each afferent volley demanding its own motor encore"*  ***Clinical Validation***   | ***Observation*** | ***Explained by Hypothesis*** | | --- | --- | | *>5 beats pathological* | *Minimum volleys needed for sustained rhythm* | | *Ankle predominance* | *Longest nerve → Maximal temporal dispersion* | | *Velocity-dependence* | *Faster stretch → More receptors recruited* | | *33 Hz frequency* | *Matches 30ms delay (1/0.03s = 33 Hz)* |   ***Conclusion: The Neurology of Desynchronization***  *This model reveals clonus as:*  *"A temporal breakdown in neural orchestration - where lost cortical conduction exposes the inherent asynchrony of sensory pathways, converting singular stimuli into rhythmic motor cascades."*  *Diagnostic Imperatives:*   1. *Test for >5 beats even without hyperreflexia* 2. *Prioritize ankle assessment (highest diagnostic yield)* 3. *Early intervention prevents circuit entrenchment* |

***Clonus: 2nd Pathophysiological Hypothesis***

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

*[video](https://youtu.be/DYh-R7gOe-Q)*[*To watch a detailed video explaining this hypothesis, click:*](https://youtu.be/DYh-R7gOe-Q)

*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. (Figure 2).*

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***Figure 2: Second Hypothesis of Clonus Pathophysiology****(The Lifecycle of Pathological Oscillations)*

*[[video](https://youtu.be/DYh-R7gOe-Q)For video explanation, click here:](https://youtu.be/DYh-R7gOe-Q" \t "_blank)*

***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*

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

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| *[video](https://youtu.be/ClqHfY65WQI)* | [*The Spinal Reflex, New Hypothesis*](https://drive.google.com/file/d/1Nh0yxWLf3gPOlSKdftIZykUjb3xpsPBe/view?usp=sharing) *of Physiology* |
| *[video](https://youtu.be/qlgZUbWVXzs)* | [*The Hyperreflexia, Innovated Pathophysiology*](https://drive.google.com/file/d/14TlTu_9KrF0DGbEDE_VgCpYdSAzBMVU7/view?usp=sharing) |
| *[video](https://youtu.be/kwwsHHKh0AQ)* | [*The Spinal Shock*](https://drive.google.com/file/d/1qQ6Ch-mVj1boww9SAhkPVTwFhX2kVoXR/view?usp=drive_link) |
| *[video](https://youtu.be/rBk0X29hs6w)* | [*The Spinal Injury, the Pathophysiology of the Spinal Shock, the Pathophysiology of the Hyperreflexia*](https://drive.google.com/open?id=1qQ6Ch-mVj1boww9SAhkPVTwFhX2kVoXR) |
| *[video](https://youtu.be/rBk0X29hs6w)* | [*Upper Motor Neuron Lesions, the Pathophysiology of the Symptomatology*](https://drive.google.com/file/d/1kwE-QYZWVzHsadu0wFL4Ckl5o2hGaxMe/view?usp=sharing) |
| *[video](https://youtu.be/G6my9xo1iM8)* | [*The Hyperreflexia (1), the Pathophysiology of Hyperactivity*](https://drive.google.com/file/d/1vZcRPdwBC4iqv8jwi3YewvOv9yKfegt4/view?usp=drive_link) |
| *[video](https://youtu.be/q1mMORyoNLY)* | [*The Hyperreflexia (2), the Pathophysiology of Bilateral Responses*](https://drive.google.com/file/d/1Gd85ZcKFIMG_0H6QeE7mez4-XvP1o2OV/view?usp=sharing) |
| *[video](https://youtu.be/5iViwU_y3-M)* | [*The Hyperreflexia (3), the Pathophysiology of Extended Hyperreflex*](https://drive.google.com/file/d/18soM_THFCzezkfBfBEG9UdoO0qWHLGlz/view?usp=sharing) |
| *[video](https://youtu.be/PteMImPyZ0A)* | [*The Hyperreflexia (4), the Pathophysiology of Multi-Response Hyperreflex*](https://drive.google.com/file/d/1xRj0t5guxfzMsl3b0aeg6SHdWCwlQIEw/view?usp=sharing) |
| *-* | [*The pathophysiology of Triple flexion Reflex*](https://drive.google.com/file/d/1xFP0BCEKknK_AzEHrimcsFjgl7TkgF1K/view?usp=drive_link) |
| *[video](https://youtu.be/crbdk1RTU64)* | [*The Clonus, 1st Hypothesis of Pathophysiology*](https://drive.google.com/file/d/1WoXzIR5GdtpjYZ-4UjfFt62Kat6rn8K8/view?usp=sharing) |
| *[video](https://youtu.be/DKdPe-RJsn4)* | [*The Clonus, 2nd Hypothesis of Pathophysiology*](https://drive.google.com/file/d/1YOWvqNtk818HbIQVaevYI-dwIk4Bonsj/view?usp=sharing) |
| *[video](https://youtu.be/1nP8K8aW3uE)* | [*The Clonus, Two Hypotheses of Pathophysiology*](https://drive.google.com/file/d/1YOWvqNtk818HbIQVaevYI-dwIk4Bonsj/view?usp=sharing) |
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| *[video](https://youtu.be/jqfp4e2t9jU)* | [*The Nerve Transmission through Neural Fiber, Personal View vs. International View*](https://drive.google.com/open?id=1HYCsolqvWnlD9dbmqKzKc1wSo6CnFxwn) |
| *[video](https://youtu.be/6ChlKWK4OLs)* | [*The Nerve Transmission through Neural Fiber (1), The Action Pressure Waves*](https://drive.google.com/open?id=1OPh2-qAwl2LqWLxdKY_WhJdFAKmCbbcC) |
| *[video](https://youtu.be/_ayskJT4v5c)* | [*The Nerve Transmission through Neural Fiber (2), The Action Potentials*](https://drive.google.com/open?id=1T3EBNAcw_a5S4AoTJRdbOUpY0tVCtU4Y) |
| *[video](https://youtu.be/55zCk35swKs)* | [*The Nerve Transmission through Neural Fiber (3), The Action Electrical Currents*](https://drive.google.com/open?id=1w62cTew8Rdr0nQnaBUvVQmhc2vNI7iTj) |
| *[video](https://youtu.be/5A-S1GgHqjk)* | [*The Function of Standard Action Potentials & Currents*](https://youtu.be/5A-S1GgHqjk) |
| *[video](https://youtu.be/GkSeiaw2vMk)* | [*The Three Phases of Nerve transmission*](https://drive.google.com/open?id=1qSxDdr6CutOhf-Jshr4khVVzjYiNX0vi) |
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| *[video](https://youtu.be/OJ7B5uYBjJU)* | *[Neural Conduction in the Synapse (Innovated)](https://drive.google.com/file/d/1zsVbsJKN-JefkMdGBJcRKbBzjX4ly24S/view?usp=share_link)* |
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| *[video](https://youtu.be/BLTTas1CF8c)* | [*Nodes of Ranvier, the Equalizers*](https://drive.google.com/open?id=1e0zPzYHnHfzR6pswcgyr5jF8rUi_yo77) |
| *[video](https://youtu.be/_uIAVuMdTvw)* | [*Nodes of Ranvier, the Functions*](https://drive.google.com/open?id=15E7qLoDIl4glTeAKBs15tvn-5Q99p1nF) |
| *[video](https://youtu.be/Aad-ynawPrs)* | [*Nodes of Ranvier, First Function*](https://youtu.be/hZ_bzG8kiFE) |
| *[video](https://youtu.be/zGRVmB0zta0)* | [*Nodes of Ranvier, Second Function*](https://youtu.be/OqH6r2qhmxY) |
| *[video](https://youtu.be/uP4QKEZsanA)* | [*Nodes of Ranvier, Third Function*](https://youtu.be/IFSf8eo8V9Y) |
| *[video](https://youtu.be/WtCIWXXP8wU)* | [*Node of Ranvier, The Anatomy*](https://youtu.be/WtCIWXXP8wU) |
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| *[video](https://youtu.be/sEuDDBoeCIA)* | [*The Wallerian Degeneration*](https://drive.google.com/open?id=1Al56zec4gm7qWRkIN1EWuXnDu6Fa-Puz) |
| *[video](https://youtu.be/CGyaV6w5594)* | [*The Neural Regeneration*](https://drive.google.com/open?id=18k3PJaNlLYsL_B6K6Mvb1Fg5gYHJJuSN) |
| *[video](https://youtu.be/1CkexgXUv2A)* | [*The Wallerian Degeneration Attacks Motor Axons, While Avoids Sensory Axons*](https://drive.google.com/open?id=16UIXUrcsMn2_pHNeDbAlIkqjwK6vVA8R) |
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| *[video](https://youtu.be/VRTXlfXutUs)* | [*The Sensory Receptors*](https://drive.google.com/open?id=1kii7l4bCrQ-Zey4sCO51mqZ5DSXUNO2H) |
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| *[video](https://youtu.be/zDgKMpNvQHI)* | [*Nerve Conduction Study, Wrong Hypothesis is the Origin of the Misinterpretation (Innovated)*](https://drive.google.com/open?id=1tEuDZryjUH1aBm9D0F9eQ9ME9KkfcpJL) |
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| *[video](https://youtu.be/ERg0rdaDsZ4)* | [*Piriformis Muscle Injection\_ Personal Approach*](https://drive.google.com/file/d/1d0p-Zx0KOSG3LO29xmdH4R-vMKBgULIf/view?usp=sharing) |
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| *[video](https://youtu.be/K_4NgfxD18g)* | [*The Philosophy of Pain, Pain Comes First! (Innovated)*](https://drive.google.com/open?id=1HHkOUQnYOy2yrnl6h68dLt0fL0V6toDO) |
| *[video](https://youtu.be/LWLXuXbs4yI)* | [*The Philosophy of the Form (Innovated)*](https://drive.google.com/open?id=1qFVpN21binPozXFCcuGrf-io0nDLlBi3) |
| *[video](https://youtu.be/sYFlZ-2EM20)* | [*Pronator Teres Syndrome, Struthers-Like Ligament (Innovated)*](https://drive.google.com/open?id=103EXeNX0ekUNDZjyLyU1pJLaz_sSyAia) |
| *[video](https://youtu.be/wofEWjGJFS0)* | [*Ulnar Nerve, Congenital Bilateral Dislocation*](https://drive.google.com/file/d/1V2mKzzV_RjoCYoJ0LRBelClJmiRv-ZnX/view?usp=sharing) |
| *[video](https://youtu.be/9u9yDd8NIoE)* | [*Posterior Interosseous Nerve Syndrome*](https://drive.google.com/open?id=1JsmICiXRYKNbYg3CiW9YlZm4pRBJ5SOB) |
| *[video](https://youtu.be/yLyRSiN2EEo)* | [*The Multiple Sclerosis: The Causative Relationship Between The Galvanic Current & Multiple Sclerosis?*](https://drive.google.com/file/d/1M0GTyJSsuc9ZWo8FnHPensmcptwHr0mR/view?usp=sharing) |
| *[video](https://youtu.be/6XkNgguYEz4)* | [*Cauda Equina Injury, New Surgical Approach*](https://drive.google.com/file/d/1Pux0iKaOxZxkVPYAZzJmVfWeu2Oz-mVC/view?usp=sharing) |
| *[video](https://youtu.be/ZlNvPM0fh8A)* | [*Carpal Tunnel Syndrome Complicated by Complete Rupture of Median Nerve*](https://drive.google.com/file/d/1sHhWsaH47QJ5PzCDWlFd2KqiExBcONyl/view?usp=sharing) |
| *[video](https://youtu.be/rJoXOrr_IIE)* | [*Biceps Femoris' Long Head Syndrome (BFLHS)*](https://drive.google.com/file/d/14y1g0Y9ThOqYRwJOsh1e5FIuxUurYDgJ/view?usp=sharing) |
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| *[video](https://youtu.be/2twXxX6T9zY)* | [*Barr Body, The Whole Story (Innovated)*](https://drive.google.com/open?id=1MsjgYESiWd3slc7i9s9mSiwOAnWFfrys) |
| *[video](https://youtu.be/VsmAEwMexmE)* | [*Adam's Rib and Adam's Apple, Two Faces of one Sin*](https://drive.google.com/open?id=1SEtq6SqQxNHHOn0q4TqrS2mhVumXNQv5) |
| *[video](https://youtu.be/jjl8SMMkLeA)* | [*Adam's Rib, could be the Original Sin?*](https://drive.google.com/open?id=10CEzaQ2cbFr6CQI-d8VTur7Ekq2VnyF0) |
| *[video](https://youtu.be/Ofn55E_fYJI)* | [*Barr Body, the Second Look*](https://drive.google.com/file/d/1-aKUsKo4-IIkdd9BsKK70iYutlycSwl6/view?usp=sharing) |
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| *[video](https://www.youtube.com/watch?v=kj9OggVj50E)* | [*Who Decides the Sex of Coming Baby?*](https://drive.google.com/file/d/1fxYwPRwuwGr5sv183v1m7LEwx24jpjf0/view?usp=sharing) |
| *[video](https://youtu.be/byGU-uDGAzM)* | [*Boy or Girl, Mother Decides!*](https://drive.google.com/open?id=1Mq5x5lqJ1givipdwAjcFyHAkEqdiJIdH) |
| *[video](https://youtu.be/L0Odkd-9ZHY)* | [*Oocytogenesis*](https://drive.google.com/file/d/1UR57GGSvkorIaZCrBbjwWT2FCngu4x21/view?usp=sharing) |
| *[video](https://youtu.be/AA252qjldLk)* | [*Spermatogenesis*](https://drive.google.com/file/d/1dFhcEwK7X9_80oogfleEqy34PmuYHTb6/view?usp=sharing) |
| *[video](https://youtu.be/kQQxHeSzUn4)* | [*This Woman Can Only Give Birth to Female Children*](https://drive.google.com/file/d/1RLsOrpSIqwaR8FpwVi4fg5ep1G5JqIg_/view?usp=sharing) |
| *[video](https://youtu.be/PYJtcfPs8mI)* | [*This Woman Can Only Give Birth to Male Children*](https://drive.google.com/file/d/1AuNzWbVMNIb48U34jkaDUveEqXXiPZGp/view?usp=sharing) |
| *[video](https://youtu.be/__xbNXe8qNU)* | [*This Woman Can Give Birth to Female Children More Than to Male Children*](https://drive.google.com/file/d/1vTtka8UuJNytX_ENOuMNnf3Tdjlh62pu/view?usp=sharing) |
| *[video](https://youtu.be/M5bRtMwcj94)* | [*This Woman Can Give Birth to Male Children More Than to Female Children*](https://drive.google.com/file/d/1D91xR5HCmVGdOSTBEiWOV6nz2gvxxrpS/view?usp=sharing) |
| *[video](https://youtu.be/BXtbeYa6Nek)* | [*This Woman Can Equally Give Birth to Male Children & to Female Children*](https://drive.google.com/file/d/1EkNaarumQgOwxLQicLFd8Ab4nGWWzej9/view?usp=sharing) |
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| *[video](https://youtu.be/zmAQkMtKkME)* | [*Eve Saved Human Identity; Adam Ensured Human Adaptation*](https://drive.google.com/file/d/1UDzf2KjgQgOFEfJG9eKlIdrrpgafkNls/view?usp=sharing) |
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| *[video](https://youtu.be/H6GaaNu7U3s)* | [*Coronavirus (Covid-19): After Humiliation, Is Targeting Our Genes*](https://drive.google.com/file/d/1qlQnlS-PBrSVan0HWubuMQzwnFwFP9UY/view?usp=sharing) |
| *[video](https://youtu.be/H6GaaNu7U3s)* | [*Coronavirus (Covid-19): After Humiliation, Is Targeting Our Genes*](https://drive.google.com/file/d/1qlQnlS-PBrSVan0HWubuMQzwnFwFP9UY/view?usp=sharing) |
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| *[video](https://youtu.be/QiL2et83B6Q)* | [*Mitosis in Animal Cell*](https://drive.google.com/file/d/1pekYoORykP7Bbl6o-VMAI8pJPcj1JVYh/view?usp=sharing) |
| *[video](https://youtu.be/PHOY1qlw0AM)* | [*Meiosis*](https://drive.google.com/file/d/1-a1NFgX0ndKYY6GRrEBJSmCpEBiOXnzx/view?usp=sharing) |
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| *[video](https://youtu.be/8OIvbXZ0xM4)* | [*Universe Creation, Hypothesis of Continuous Cosmic Nebula*](https://drive.google.com/file/d/1Hs27xIEXwX7Yb9a5XvoiM_Qk5o3ufmUg/view?usp=sharing) |
| *[video](https://youtu.be/UPyZWXSon3Y)* | [*Circulating Sweepers*](https://drive.google.com/file/d/1FIZvJF67F5te_ye8V1mZDx_aVtF2k8tc/view?usp=sharing) |
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| *[video](https://youtu.be/wB1F9p8PICE)* | [*Pneumatic Petrous, Bilateral Temporal Hyperpneumatization*](https://drive.google.com/file/d/1lbewP5eC703bxcRw0VZV2W1x4OY9oStV/view?usp=sharing) |
| *[video](https://youtu.be/Z2D0HCZgDqY)* | [*Congenital Bilateral Thenar Hypoplasia*](https://drive.google.com/file/d/1UVKs2UyHbSpiwbEqWugkA881FUIot06M/view?usp=sharing) |
| *[video](https://youtu.be/pftu_ZNUy9w)* | [*Ulnar Dimelia, Mirror hand Deformity*](https://drive.google.com/file/d/15EJ_xT13PAwDhw3GEypnt0gqBzvzvVug/view?usp=sharing) |
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| *[video](https://youtu.be/72J4c7Gof-g)* | [*Surgical Restoration of a Smile by Grafting a Segment of the Gracilis Muscle to the Face*](https://drive.google.com/file/d/14AZMJJjeaVTdPn3wxPn7e2XqlRGdOPzq/view?usp=drive_link) |
| *[video](https://youtu.be/Dn4vEpJYaSg)* | [*Mandible Reconstruction Using Free Fibula Flap*](https://drive.google.com/file/d/1Nv2YLBSc5TC7VFXBUVp9KAga4eUQmqfg/view?usp=sharing) |
| *[video](https://youtu.be/wLhKIBIb3gA)* | [*Presacral Schwannoma*](https://drive.google.com/file/d/1EzZ10x4KR3ep0Xp4Ldq1f2u9u8SECNP9/view?usp=sharing) |
| *[video](https://youtu.be/-q9DZFaKwF8)* | *[Liver Hemangioma: Urgent Surgery of Giant Liver Hemangioma](https://drive.google.com/file/d/1ui0t-Ao-st4GeijhyaXc1Hjbj9uYaaKy/view?usp=sharing)*  *[Due to Intra-Tumor Bleeding](https://drive.google.com/file/d/1ui0t-Ao-st4GeijhyaXc1Hjbj9uYaaKy/view?usp=sharing)* |
| *[video](https://youtu.be/MQShaLlN-Y0)* | [*Free Para Scapular Flap (FPSF) for Skin Reconstruction*](https://drive.google.com/file/d/1Z1hkl2E6N95ld1tXIYaTfvL6lw4mqQ1P/view?usp=sharing) |
| *[video](https://youtu.be/4dC-2vNDGpI)* | [*Claw Hand Deformity (Brand Operation*](https://youtu.be/4dC-2vNDGpI)*)* |
| *[video](https://youtu.be/fDjXCSHGuvA)* | [*Algodystrophy Syndrome Complicated by Constricting Ring at the Proximal Border of the Edema*](https://drive.google.com/file/d/1D-h2Ck-VdsJyA5dukbliwXwOh_-t2HUz/view?usp=sharing) |
| *[video](https://youtu.be/OKv1iogYIMA)* | [*Non- Traumatic Non- Embolic Acute Thrombosis of Radial Artery (Buerger’s Disease)*](https://drive.google.com/file/d/1ZaKpD0XVdQxY6FR44PyBeFfv_RKzXj_x/view?usp=sharing) |
| *[video](https://youtu.be/2hJw4jKCyfg)* | [*Isolated Axillary Tuberculosis Lymphadenitis*](https://drive.google.com/file/d/1aC9W8XO6UNHljyS3iAwlP2fiuH85D3Lr/view?usp=sharing) |
| *[video](https://youtu.be/rKabisSM5MQ)* | [*The Iliopsoas Tendonitis... The Snapping Hip*](https://drive.google.com/file/d/1NUslspZfeaO5W4Hu2bJPNjq7syQlgQ2t/view?usp=drive_link) |
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| *[video](https://drive.google.com/file/d/1m_O7jCbrw-oT98vb4y2hs_ztznRC5pat/view?usp=sharing)* | [*The Lone Wolf*](https://drive.google.com/file/d/1B0osXS1SW7h-xfWwCN8DN2Nk4QF4eqB5/view?usp=drive_link) |
| *[video](https://drive.google.com/file/d/1fpXPiIpTxRl3IT_dMeLzFj1ZXd4Bo6p1/view?usp=sharing)* | [*The Delirium of Night and Day*](https://drive.google.com/file/d/1pKdYMAPUPrdtWBXrRXYZYlGIPg3G9Xhb/view?usp=drive_link) |
| *[video](https://drive.google.com/file/d/1dOsuna7dES5isqemZgkfpJH_HIyLsiAs/view?usp=sharing)* | [*The Delirium of the Economy*](https://drive.google.com/file/d/1OtDMBt439gOf12SFE73W0Re09ldEuU9U/view?usp=drive_link) |
| *[video](https://drive.google.com/file/d/1yo1yDuNxdD7i_Edi9CnaCUjmp0_A85fM/view?usp=drive_link)* | [*Ovaries in a Secure Corner… Testicles in a Humble Sac: An Inquiry into the Function of Form*](https://drive.google.com/file/d/1DeALuwHlQ_kThaVk--W_P04b9MksjiWD/view?usp=drive_link) |
| *[video](https://drive.google.com/file/d/17HUzsFJW5-QTSNdM-KrrMb3VDi9erYyp/view?usp=sharing)* | [*Eve Preserves Humanity’s Blueprint; Adam Drives Its Evolution*](https://drive.google.com/file/d/19kB5tQ9UIeaen29iyOZwZlgqG0r3IynI/view?usp=drive_link) |

*2/6/2020*