

## ***The Neural Conduction in Neural Fiber*** ***(Personal View)***

***N.B. the Arabic version of this article is the reference,  
read it on the following links:***

 [النَّقْلُ العَصْبِيُّ، مُقَارِبَةٌ شَخْصِيَّةٌ لِآلِيَّةِ النَّقْلِ العَصْبِيِّ عِبْرَ المَحَاوِرِ العَصْبِيَّةِ](#)  
[Neural Conduction in Neural Fibers, Personal View vs. International View](#)

*I do believe the neural conduction in the neural fibers is simpler than the worldwide conception. Moreover, I do believe the corner stone of the neural conduction in the neural fiber is a pressure impulse generated at the distal limit of the axon hillock in the motor neuron, and in the sensory receptors in the sensory neuron.*

*Hereafter, I will develop my personal view of the neural conduction in the neural fibers.*

### ***1. The Resting Pressure***

*At rest, a positive pressure dominates inside the soma (the cell body of the neuron) and inside the neural fibers as well. The Resting Pressure is the base line. It is essential for a good function of the neural fibers. Moreover, it determines the parameters of the Action Pressure Wave, hence the velocity of the neural conduction.*

*For more details concerning this item, see the following video:* 

### ***2. The Central Action Pressure Wave***

*In the axon hillock of the motor neuron, after reaching the threshold, the massively present microtubules contract and withdraw backward into the soma. Thus, a Central Pressure Wave is created.*

*The Central Pressure Wave invades the intracellular space of the soma reaching its well-enforced cell membrane. The cell membrane will push back the pressure wave, and oblige it to return to the axon hillock.*

*The rebound pressure wave will violently hit the withdrawing microtubules' montage and enforce it to go far peripherally thus announcing the creation of the Action Pressure Wave; which is the actual porter of the neural signal.*

*For more details concerning this item, see the following video:* 

### **3. The Action Pressure Wave**

*The Action Pressure Wave is the real porter of the neural signal in the neural fibers of both the motor and the sensory neurons. Actually, for one shot of neural conduction there will be one single Action Pressure Wave. However, the parameters of this pressure impulse will be treated.*

*At the beginning, because of the violent nature of its creation, the Action Pressure Wave starts with unsuitable high parameters. Then, upon its passage through the 1<sup>st</sup> node of Ranvier, the wave will take the standard parameters. Therefore, I used two terms; the Preliminary Action Pressure Wave and the standard Action Pressure Wave, in order to describe this alteration of the wave's parameters.*

*For more details concerning this item, see the following video:* 

#### **3.1. The Preliminary Action Pressure Wave**

*The Action Pressure Wave starts with elevated parameters due to its violent creation inside the axon hillock. The Preliminary Action Pressure Wave will be the name in such a case. It spreads throughout the pre-nodal segment of the axon. Then, it is at the first node of Ranvier where the Action Pressure wave will take the standard parameters, and will change the name as well. From now on, we talk about the Standard Action Pressure Wave.*

*For more details concerning this item, see the following video:* 

#### **3.2. The Standard Action Pressure Wave**

*Since the 1<sup>st</sup> node of Ranvier, the parameters of the Action Pressure Wave will be treated to be within the standards. It will take a pre-designed wavelength, amplitude, and velocity. Hence, it is called the Standard*

*Action Pressure Wave, and is continuing in such a way throughout the neural fiber thanks to the following nodes of Ranvier.*

*For more details concerning this item, see the following video:* 

## **4. The Action Potentials**

*Here, we are talking about many Action Potentials during one shot of neural conduction. There will be one Preliminary Action Potential at the beginning, a group of Standard Action Potentials in the middle, and one Terminal Action Potential at the end.*

*For more details concerning this item, see the following video:* 

### **4.1. The Preliminary Action Potential**

*As mentioned before, in the axon hillock of the motor neuron, after reaching the threshold, the massively present microtubules contract and withdraw backward into the soma. Thus, an area of negative pressure is created inside the axon hillock.*

*The induced negative pressure opens the gates of sodium channels and invites the sodium ions into the lumen of the axon hillock. These incoming positive sodium ions will invert the polarity of the intracellular cytoplasm of the axon hillock to a positive polarity. Whereas, the polarity of the rest of the axon's cytoplasm remains negative mainly due to the negative polarity of the intracellular proteins.*

*Consequently, the incoming positive sodium ions will create the cathode of the Preliminary Action Potential inside the axon hillock, whereas the negative polarity of the pre-nodal segment of the axon will make the anode.*

*For more details concerning this item, see the following video:* 

### **4.2. The Standard Action Potentials**

*In similar way, when the Action Pressure Wave reaches the 1<sup>st</sup> node of Ranvier, the negative pressure of its trough (the rarefaction) will open the gates of the pressure-gated Na<sup>+</sup> ion channels of the cell membrane and will absorb the sodium ions into the intracellular space. Thus, it creates the cathode of the first Standard Action Potential. The anode of the Action*

*Potential is already present thanks to the negative polarity of the intracellular cytoplasm. Thus, the Standard Action Potential is generated.*

*The process will repeat on at each of the following nodes of Ranvier. Consequently, we will have a homogenous group of Standard Action Potentials. They follow each other consecutively. The previous one will have no influence on the present one, and the present one has nothing to do with the next one. In fact, the negative pressure of the trough of the Action Pressure Wave is the only starter of a such process, and the nodes of Ranvier are the actual generating stations of all these Standard Action Potentials.*

*Each Standard Action Potential acts on its inter-nodal segment, thus builds and optimizes the trajectory of the imminent Action Pressure Wave in that segment. The sum of these segmental trajectories will make the entire trajectory of the Action Pressure Wave.*

*For more details concerning this item, see the following video:* 

### **4.3. The Terminal Action Potential**

*It is the last Action Potential in the neural conduction. Its cathode is built in the presynaptic knob by the negative pressure of the trough of the Action Pressure Wave.*

*Immediately after its arrival, the negative pressure of the wave's trough opens the gates of the pressure-gated  $Ca^{++}$  ion channels of the cell membrane. It absorbs the  $Ca^{++}$  ions into the presynaptic knob, thus builds a positive polarity inside the knob. Whereas the anode is already present in the postsynaptic dendrites because of the negative polarity of the intracellular cytoplasm.*

*It is a trans-synaptic Action Potential. It is of a high positive polarity due to the high polarity of the  $Ca^{++}$  ions on one hand, and due to the greater volume of the knob on the other hand.*

*For more details concerning this item, see the following video:* 

## **5. The Action Electrical Currents**

*Each one of the Action Potentials will fire its own Electrical Current. Moreover, the Electrical Current will have the name and the intensity of its generating Action Potential.*

*For more details concerning this item, see the following video:* 

### **5.1. The Preliminary Electrical Current**

*Soon after its creation, the Preliminary Action Potential will fire the Preliminary Electrical Current (PEC). The PEC starts in the axon hillock and ends in the 1<sup>st</sup> node of Ranvier.*

*For more details concerning this item, see the following video:* 

### **5.2. The Standard Electrical Currents**

*They are a homogenous group of consecutive Electrical Currents (EC)s. Each EC starts in one node of Ranvier, and ends in the next node of Ranvier. EC has the same function and the same space of action as its generating Standard Action Potential.*

*For more details concerning this item, see the following video:* 

### **5.3. The Terminal Electrical Current**

*The Terminal Electrical Current (TEC) is a single trans-synaptic Electrical Current. TEC starts in the presynaptic knob and ends in the postsynaptic effector organ. Actually, it is the real transmitter of the neural signal to the effector organ.*

*For more details concerning this item, see the following video:* 

## **6. The Function of the Standard Action Potentials & the Standard Electrical Currents**

*They build and optimize the trajectory of the imminent Action Pressure Wave in order to accelerate the wave passage throughout the neural fiber. They recruit the intracellular elements, and enforce them to be crowded in the pathway of the imminent Action Pressure Wave. In such a way, the*

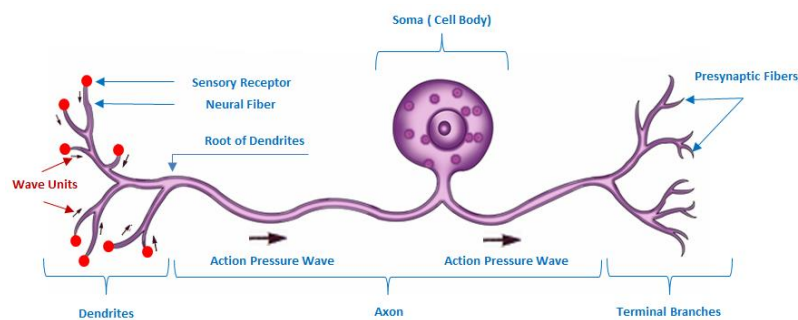
*Action Pressure Wave can rapidly run through this new, well- organized, dense, intracellular space.*

*Each couple (i.e., the Standard Action Potential and its Standard Electrical Current) works on one internodal segment. The sum of the segmental trajectories will make the whole wave trajectory.*

*[For more details concerning this item, see the following video:](#)* 

## **7. The Action Pressure Wave in the Sensory Neurons**

*In response to a stimulant, a mini pressure wave (Wave Unit) is created in every sensory receptor. At the root of the dendrites, all the wave units of the same neuron merge together to form one single Action Pressure Wave; **figure (1)**.*



**Figure (1)**  
**The Action Pressure Wave**  
**in Sensory Neurons**

*In every sensory receptor,  
a wave unit is created in response to the stimulation.  
At the root of the dendrites, all the wave units emerge together in one single Action Pressure Wave. Then, the pressure wave runs on throughout the axon at the center sector of the lumen.*

## **8. The Three Phases of the Neural Conduction**

*The neural Conduction begins with an electrical impulse and ends with an electrical impulse. Whereas, in between, there is a pressure impulse; i.e., the Action Pressure Wave.*

*Since the pressure wave does not perfectly work in an open space in such as the synaptic cleft, the electricity is used to overcome this physiological gab.*

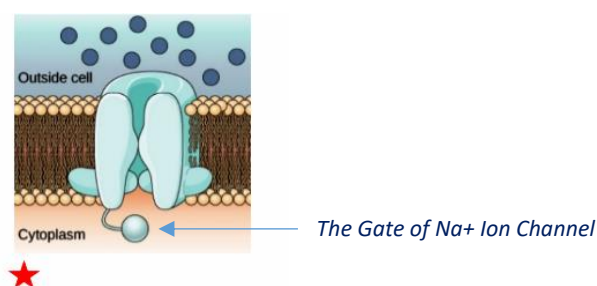
*Therefore, the neuron receives the neural signal via a transsynaptic electrical impulse, and deliver it to the postsynaptic effector organ via a transsynaptic electrical impulse as well. However, the mediator between the two electrical impulses must be a pressure impulse, which easily runs throughout the closed space of the neural fiber.*

*For more details concerning this item, see the following video:* 

## **9. The Pressure-Gated Sodium Ions Channels**

*The pressure-gated sodium ions channels are omnipresent throughout the cell membrane of the unmyelinated neural fibers. In contrast, they only exist in the cell membrane of both the axon hillock and the nodes of Ranvier of the myelinated neural fiber. They play the essential role in the generation of the Action Potentials and their Electrical Currents.*

*The pressure-gated sodium ion channel consists of a channel through which the sodium ions pass, and a gate that controls the one-way outside-to-inside passage through the channel. The gate is connected to the inner wall of the channel, which receives the front of the Action Pressure Wave at first; **figure (2)**.*



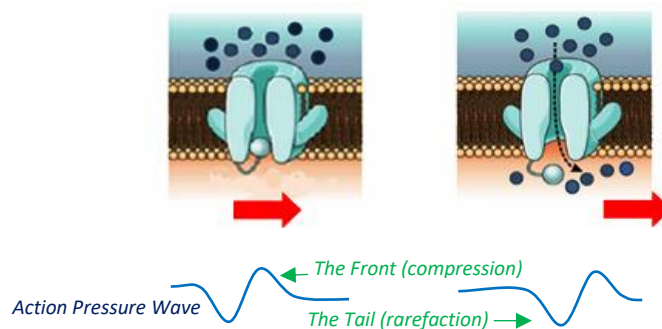
**Figure (2)**  
**The Pressure- Gated Sodium Ion Channel**

*It is a communicative channel between the outside cell and the cytoplasm. The gate is connected to the inner wall of the channel that receives the front of the Action Pressure Wave at first.*

**N.B.** *The red star refers to the site of birth of the Action Pressure Waves. i.e., the side of the cell body in the motor neurons, and the side of the sensory receptors in the sensory neurons. The blue balls refer to the extracellular sodium ions  $Na^+$ .*

The gate's architecture of the sodium ion channel implies the role of the pressure wave in its function. It is logical to refer the gate's closure to the high pressure of the wave's front, and to refer its opening to the negative pressure of the wave's tail.

During the passage of the Action Pressure Wave at the level of the channel, the high pressure of the front will push up the gate and will close the channel for a while. However, it is the role of the negative pressure of the wave's tail to open the gate of the sodium channel, and to invite the sodium ions into the lumen of the neural fiber; **figure (3)**.



**Figure (3)**  
**Pressure-Gated Sodium Ion Channel in Action**

The high pressure of the front of the Action Pressure Wave pushes up the gate and subsequently closes the channel. After a while, the negative pressure of the tail of the wave will open the gate, and will invite the sodium ions into the lumen of the neural fiber.

**Note1:** the red large arrows locate the site and the direction of the front of Action Pressure Wave in a specific moment.

**Note2:** The two green arrows refer to the sector of wave in action in the same specific moment.

**Note3:** The blue balls represent the sodium ions  $\text{Na}^+$ .

## 10. The Myelin Sheath

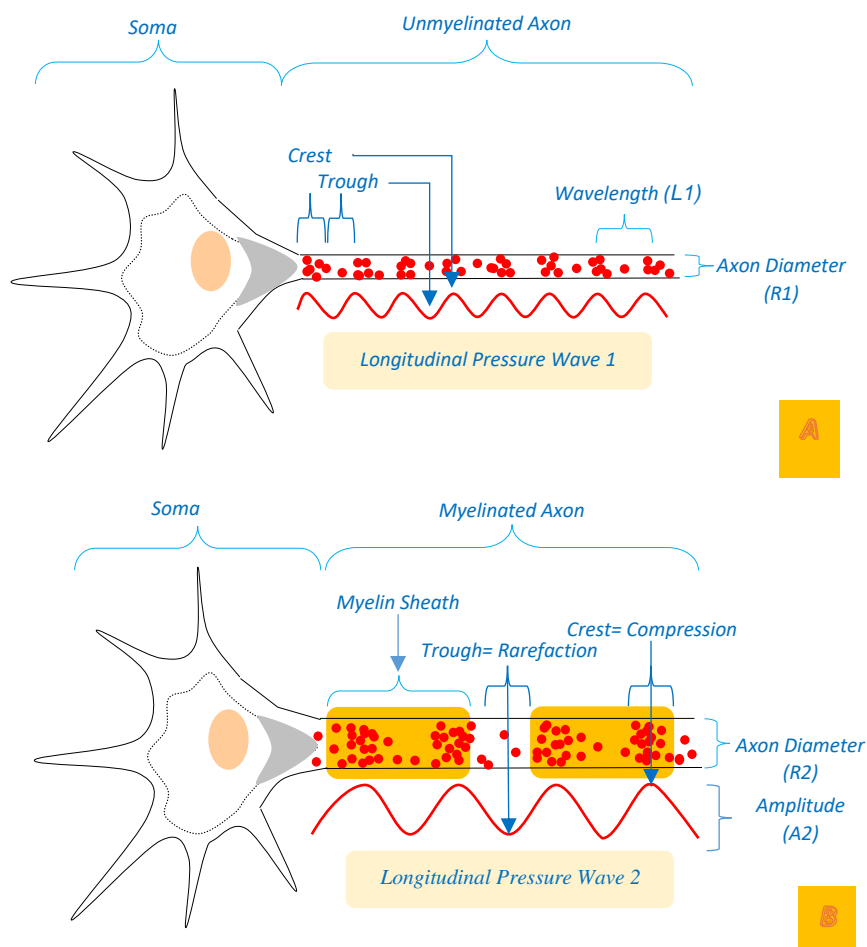
Like any other longitudinal wave, the pressure wave has its parameters, i.e., the wavelength and amplitude, the wave velocity, and the wave energy. The velocity of the pressure wave is proportionally related to its wavelength. The wavelength increases, its velocity increases and all the other parameters increase as well.

Moreover, to generate an Action Pressure Wave of high velocity, it is obligatory to build an elevated Resting Pressure inside the neural fiber.



The cell membrane of neural fiber per se cannot tolerate the elevated values of both the Resting Pressure and the Action Pressure Wave. For that reason, the neuron enforces its neural fibers of high velocity par the Myelin Sheath.

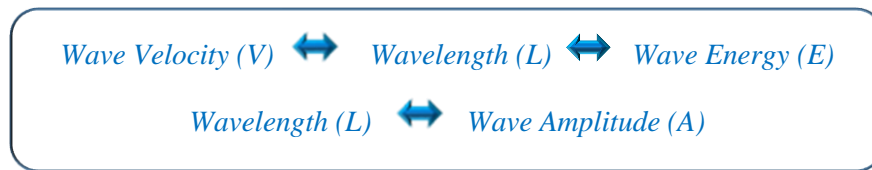
The Myelin Sheath enables the neuron to build wider and stronger neural fibers. The last two parameters of neural fiber are indispensable for fast neural conduction. For this reason, the neural conduction in the myelinated neural fibers is faster than the neural conduction in the unmyelinated ones; **figure (4)**.



**Figure (4) Myelin Sheath is Indispensable Tool for Fast Neural Conduction**

Like any other longitudinal wave, the wave's energy and velocity of the Action Pressure Wave are proportionally correlated to its wavelength. The wavelength and the wave amplitude are attached to each other. Consequently, a faster Action Pressure Wave is equivalent to a longer wavelength, and to a higher wave amplitude. Therefore, in order to obtain a faster neural conduction, it is obligatory for the neurons to

*build wider and stronger neural fiber that can tolerate the Action Pressure Waves of high energy and velocity. Their tool to do so is the Myelin Sheath.*



**Figure (A) Unmyelinated Neural Fiber:** *is of a small diameter ( $R_1$ ). The small unmyelinated fiber is fit with Action Pressure Wave of a short wavelength and of a slow velocity ( $V_1$ ).*

**Figure (B) Myelinated Neural Fiber:** *The Myelin Sheath permits to build a wider ( $R_2$ ) and a stronger neural fiber. Thus, a longer and a faster pressure wave can freely run in without difficulties.*

$$R_2 > R_1 \rightarrow V_2 > V_1$$

**Note:** *the red balls represent the intracellular elements, i.e., the intracellular proteins, the intracellular ions, the micro vesicles.*

## **The Summary**

*This is my way to understand the neural conduction in the neural fiber. I insist on the essential role of the pressure wave in the process.*

*In the motor neuron, the Action Pressure Wave is born at the distal portion of the axon hillock. In response to a stimulant, the microtubules of the axon hillock contract generating the Central Pressure Wave. The Central Pressure Wave rebounds back from the enforced membrane of the cell body. The rebounding wave hits the contracted microtubules and pushes them distally. Thus, the Action Pressure Wave is created.*

*Upon their contraction, the microtubules generate a zone of negative pressure (vacuum) inside the axon hillock. The vacuum will open the gates of the massively present sodium ion channels, and will absorb the positive sodium ions  $Na^+$  in.*

*The incoming sodium ions  $Na^+$  build the cathode of the first Action Potential. The anode of the Action Potential is already present mainly due to the negative polarity of the cell inside. So that, the first Electrical Current is fired on within the lumen of the pre-nodal segment of the neural fiber.*












*In contrast, in the sensory neuron, the wave units arise distally in the sensory receptors par different method. It is the role of the sensory receptor to invert a specific spectrum of the stimulant energy to a wave pressure (wave unit). However, at the root of the dendrites, the wave units emerge together to form one single Action Pressure Wave.*

*The pressure-gated sodium ions channel allows the positive sodium ions to enter into the lumen of the neural fiber. The pressure wave controls the movement of the channels' gates. The wave's front closes the gates, while its tail opens them. In fact, it is the negative pressure of the wave's tail, which invites the positive sodium ions into the lumen of the neural fiber. The incoming sodium ions build the cathode of the Action Potential. Since the anode of Action Potential is already present, due the negatively charged intracellular proteins, the circle is complete and the electrical current is fired.*
















*The action pressure wave runs inside the neural fiber. They occupy a center sector of the neural fiber. It is the role of the nodes of Ranvier to fix its trajectory at the center of the fiber.*

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*In another context, one can read:*

-  [\*Neural Conduction, Personal View vs. International View \(Innovated\)\*](#)
-  [\*Upper Motor Neuron Lesions, Pathophysiology of Symptomatology\*](#)
-  [\*Neural Conduction, Action Pressure Waves \(Innovated\)\*](#)
-  [\*Neural Conduction, Action Potentials \(Innovated\)\*](#)
-  [\*Neural Conduction, Action Electrical Currents \(Innovated\)\*](#)
-  [\*The Function of Action Potentials \(Innovated\)\*](#)
-  [\*The Three Phases of Neural Conduction \(Innovated\)\*](#)
-  [\*Neural Conduction in the Synapse \(Innovated\)\*](#)
-  [\*Sensory Receptors\*](#)
-  [\*Nodes of Ranvier, the Equalizers \(Innovated\)\*](#)
-  [\*Nodes of Ranvier, the Functions \(Innovated\)\*](#)

-  [\*Nodes of Ranvier, First Function \(Innovated\)\*](#)
-  [\*Nodes of Ranvier, Second Function \(Innovated\)\*](#)
-  [\*Nodes of Ranvier, Third Function \(Innovated\)\*](#)
-  [\*Node of Ranvier The Anatomy\*](#)
-  [\*The Philosophy of Pain, Pain Comes First! \(Innovated\)\*](#)
-  [\*The Philosophy of the Form \(Innovated\)\*](#)
-  [\*Spinal Injury, Pathophysiology of Spinal Shock, Pathophysiology of Hyperreflexia\*](#)
-  [\*Who Decides the Sex of Coming Baby?\*](#)
-  [\*Spinal Shock \(Innovated\)\*](#)
-  [\*The Clonus \(Innovated\)\*](#)
-  [\*Hyperactivity Hyperreflexia \(Innovated\)\*](#)
-  [\*Hyperreflexia, Extended Sector of Reflex\*](#)
-  [\*Hyperreflexia, Bilateral Responses\*](#)
-  [\*Hyperreflexia, Multiple Responses\*](#)
-  [\*Nerve Conduction Study, Wrong Hypothesis is the Origin of the Misinterpretation \(Innovated\)\*](#)
-  [\*Wallerian Degeneration \(Innovated\)\*](#)
-  [\*Neural Regeneration \(Innovated\)\*](#)
-  [\*Wallerian Degeneration Attacks Motor Axons, While Avoids Sensory Axons\*](#)
-  [\*Barr Body, the Whole Story \(Innovated\)\*](#)
-  [\*Boy or Girl, Mother Decides!\*](#)
-  [\*Adam's Rib and Adam's Apple, Two Faces of one Sin\*](#)
-  [\*The Black Hole is a \(the\) Falling Star?\*](#)
-  [\*Adam's Rib, could be the Original Sin?\*](#)
-  [\*Pronator Teres Syndrome, Struthers Like Ligament \(Innovated\)\*](#)

-  [\*Function of Standard Action Potentials & Currents\*](#)
-  [\*Posterior Interosseous Nerve Syndrome\*](#)
-  [\*Spinal Reflex, New Hypothesis of Physiology\*](#)
-  [\*Hyperreflexia, Innovated Pathophysiology\*](#)
-  [\*Clonus, 1<sup>st</sup> Hypothesis of Pathophysiology\*](#)
-  [\*Clonus, 2<sup>nd</sup> Hypothesis of Pathophysiology\*](#)
-  [\*Clonus, Two Hypotheses of Pathophysiology\*](#)
-  [\*Hyperreflexia \(1\), Pathophysiology of Hyperactivity\*](#)
-  [\*Hyperreflexia \(2\), Pathophysiology of bilateral Responses\*](#)
-  [\*Hyperreflexia \(3\), Pathophysiology of Extended Hyperreflex\*](#)
-  [\*Hyperreflexia \(4\), Pathophysiology of Multi-Response Hyperreflex\*](#)
-  [\*Barr Body, the Second Look\*](#)
-  [\*Mitosis in Animal Cell\*](#)
-  [\*Meiosis\*](#)
-  [\*Universe Creation, Hypothesis of Continuous Cosmic Nebula\*](#)
-  [\*Circulating Sweepers\*](#)
-  [\*Pneumatic Petrous, Bilateral Temporal Hyperpneumatization\*](#)
-  [\*Ulnar Nerve, Congenital Bilateral Dislocation\*](#)
-  [\*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\*](#)
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-  [\*Three Steps of Neural Conduction\*](#)

01/08/2018