

The Nodes of Ranvier

The Functions & The Functional Anatomy (Personal View)

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

 [عقدة رانفويه ضابطة الإيقاع.. بحث في الوظيفة والتشريح الوظيفي](#)
[The Nodes of Ranvier.. The Equalizers](#)

The anatomy of the node of Ranvier is well illustrated. However, the function of each element of its structure (i.e., the functional anatomy) still reserve its secret until now. Here after, I will try to find out the actual functions and the functional anatomy of the node of Ranvier.

The concerned anatomical details are:

1. The Gated- Sodium Ion Channels that are massively present in the cell membrane of the node of Ranvier.
2. The Myelin Sheath that is absent at the node of Ranvier.
3. The Diameter of the Neural Fiber, which loses about one third of its value at the node of Ranvier.
4. Finally, the Microtubules & the Microfilaments that are massively present in the cytoplasm of the node of Ranvier; **figure (1)**.

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

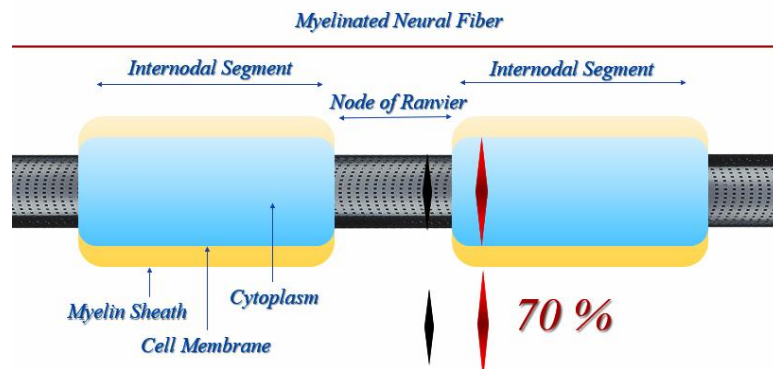


Figure (1)
The Node of Ranvier,

is only present in the myelinated neural fiber.

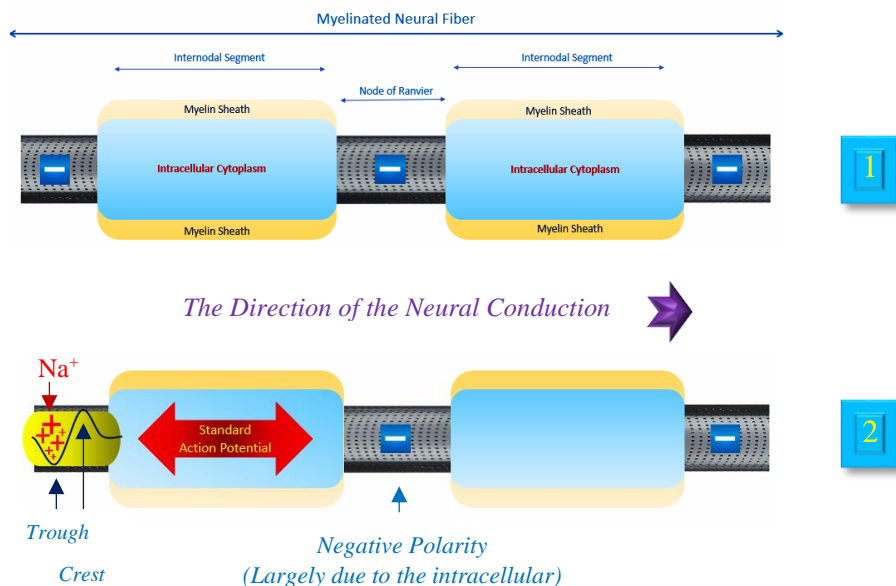
The segments of the neural fiber between two consecutive nodes are the internodal segments. The internodal segments are covered with the myelin sheath. However, at nodes of Ranvier, the neural fiber loses its myelin sheath. At the nodes of Ranvier, the cell membrane is rich of sodium ion channels. At the nodes of Ranvier, the neural fiber loses about one third of its diameter. At the nodes of Ranvier, the cell membrane is massively supported with the microtubules and the microfilaments.

1. The Nodes of Ranvier, The Generation Stations

When the Action Pressure Wave reaches the node of Ranvier, the negative pressure of its trough (the rarefaction) will open the gates of the pressure-gated Na^+ ion channels of the cell membrane and will absorb the sodium ions into the intracellular space. Thus, it creates the cathode of the 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 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; **figure (2)**.

For more details concerning this item, see the linked video: 



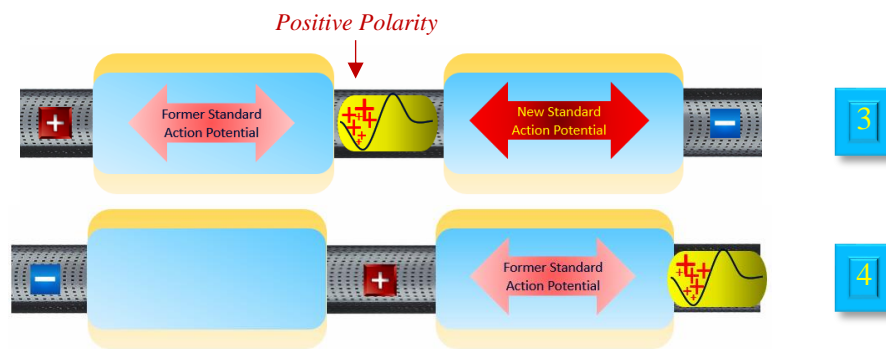


Figure (2)
The Node of Ranvier is a Generation Station

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

*In motor neurons,
the Action Pressure Wave is built at the distal portion of the axon hillock.
It runs on as a single pressure impulse. The wave has one crest and one trough.
Throughout the neural fiber, the negative pressure (Rarefaction) of the wave's tail follows
the positive pressure (Compression) of the wave's front.*

*Upon its passage through the nodes of Ranvier,
the negative pressure (rarefaction) of the tail of Action Pressure Wave opens the gates of
pressure gated sodium ion channels, and invites the sodium ions Na^+ to come into the neural
fiber. The incoming positive sodium ions charge the tail of action pressure wave with a
positive polarity.*

*Between, the recently induced positive polarity at node of Ranvier (due to the incoming Na^+)
and the preexistent negative polarity of the distal cytoplasm (largely due to the negative
polarity of intracellular proteins), the Standard Action Potential is generated.*

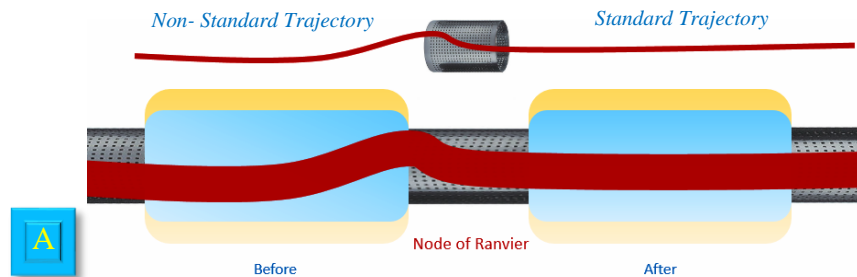
Figure (1): The neural Fiber is at rest.
Figure (2), (3), (4): The neural fiber is in action.

2. The Nodes of Ranvier, The Equalizers

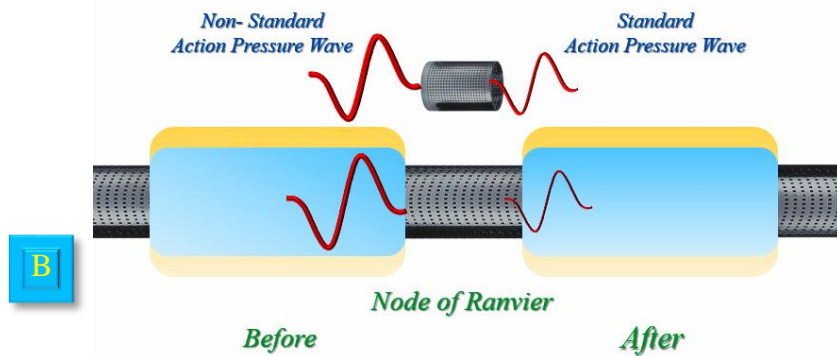
*The Nodes of Ranvier control the trajectory and the parameters of the Action
Pressure Wave, and keep them within the standards and identical throughout the
neural fiber.*

*Distributed along the myelinated neural fiber, nodes of Ranvier control
the parameters of the Action Pressure Wave, i.e., the wavelength, the
wave amplitude, the wave energy, and the wave velocity. The trajectory of
the action pressure wave is always fixed at the center of the neural fiber.
The energy of the wave is the same along the neural fiber. Every error
should be repaired and be returned to the standards. Otherwise, both the*

neural conduction, and the safety of the different structures of the neuron, will considerably be damaged; **figure (3)**.



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



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

Figure (3)
Node of Ranvier, the Equalizer
Control the Wave Trajectory and the Wave Parameters

Figure (A) whenever the action pressure wave loses its pre-determined trajectory, it is up to the next node of Ranvier to restore the wave's course again. Furthermore, the set of nodes of Ranvier plays the role of bridge pillars by suspending the wave trajectory at the center of the neural fiber.

Figure (B) at birth, the Action Pressure Wave may use almost the entire lumen of the first segment of the neural fiber. Hence, it comes in direct contact with the cell membrane. If it continues so along the neural fiber, it may harm the cellular elements. Repeated such aberrant Action Pressure Waves could damage the whole process of neural conduction.


Furthermore, somewhere of its course, the Action Pressure Wave may violate the standard wave's parameters. In such cases, the next node of Ranvier will correct the wave's parameters and oblige the aberrant Action Pressure Wave to respect the standards again, and so do the next nodes along the neural fiber.

3. The Anatomical Adaptations

For the optimal function, the anatomy of the node of Ranvier must permit a direct contact between the Action Pressure Wave and the extracellular space. Thus, the negative pressure of the tail of the Action Pressure Wave can apply direct influence on the gates of the pressure-gated sodium ion channels, as well as on the extracellular sodium ions Na^+ .

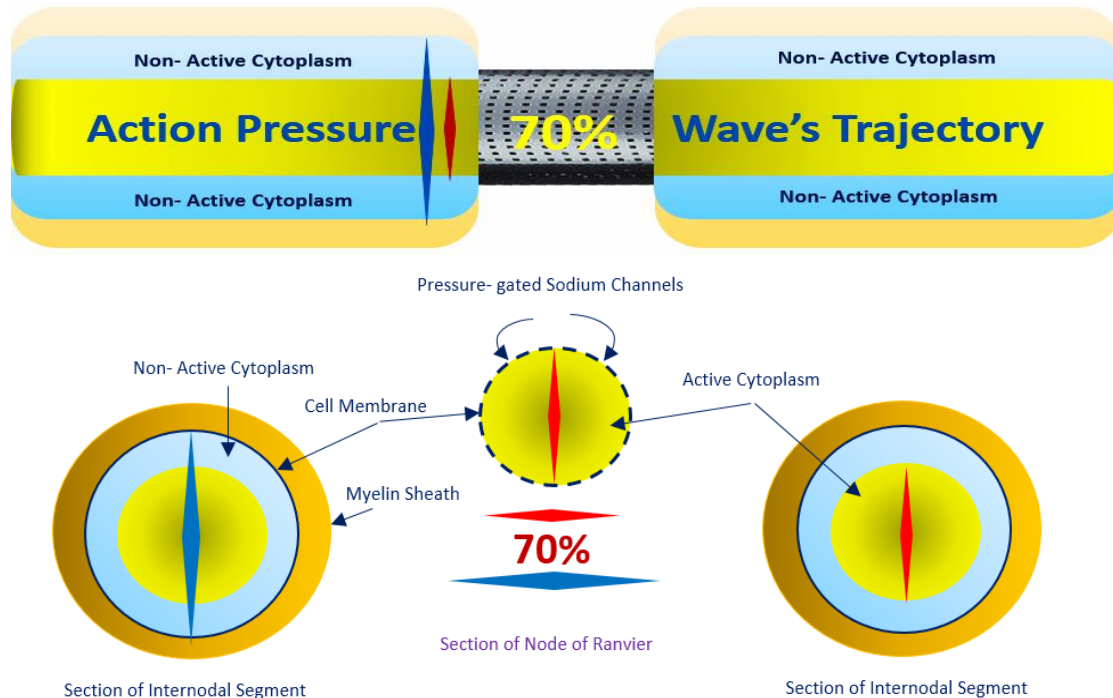
For that reason, the neural fiber changes its anatomy at the level of Ranvier's nodes. These anatomical adaptations are as follow:

- 1. It loses its myelin sheath. Myelin sheath is a barrier that prevents sucking the extracellular sodium ions into the fiber's lumen by the sucking force of the trough of the Action Pressure Wave. The incoming sodium ions are indispensable to build the positive pole of the Standard Action Potential. In turn, the Standard Action Potential optimizes the trajectory of the imminent Action Pressure Wave and hence accelerating its passage throughout the concerning internodal segment.*

[For more details concerning the actual roles of the Standard Action Potential & the Standard Electrical Currents, see the linked video:](#) 

- 2. The cell membrane comes closer to the trajectory of the Action Pressure Wave. In fact, the trajectory of the Action Pressure Wave forms an imaginary functional tube at the center of neural fiber. The Action Pressure Wave only uses the central sector of cytoplasm, which I named the functional cytoplasm. In such a way, a layer of intracellular cytoplasm rests surrounding the wave's trajectory at the intermodal segments. I named it the non-functional cytoplasm. However, at nodes of Ranvier, the surrounding non-functional cytoplasm totally disappears in order to induce direct contact between the Action Pressure Wave and the extracellular space; **figure (4)**.*
- 3. The cell membrane is provided with the channels through which the sodium ions could pass into the lumen of the neural fiber; **figure (4)**.*
- 4. New methods of protection were applied in order to support the cell membrane of the neural fiber against the harmful effects of Action Pressure Wave during the neural conduction. Since, at the level of nodes of Ranvier, the cell membrane directly subjects to the harmful effects of the Action Pressure Wave. The front's positive pressure, and*

the tail's negative pressure, both tend to disfigure the cell membrane. In order to protect the membrane, the node recruits the microtubules and the microfilaments in large quantity.



*Figure (4)
The Node of Ranvier, The Functional Anatomy*


For more details concerning this item, see the linked video: 

The Standard Action Pressure Wave only use the central sector of the cytoplasm of the neural fiber. I named this part of cytoplasm in use the Functional Cytoplasm, and I named the peripheral sector of the cytoplasm out of use the Non-functional Cytoplasm. In the Internodal Segments, the functional cytoplasm is surrounded by the non-functional cytoplasm. However, in the nodes of Ranvier, the non-functional cytoplasm disappears and the functional cytoplasm goes on alone. Dynamically, it is essential for the neural fiber membrane with all its pressure gated sodium ion channels to be in direct contact with the Action Pressure Wave. Thus, the negative pressure of the wave's tail directly manipulates both the channels' gates and the extracellular sodium ions.




















Figure (A) *the Action Pressure Wave uses the central sector of the neural fiber. The wave's trajectory looks like a central tube within an outer tube. Actually, the trajectory of the Action Pressure Wave is imaginary functional central tube, whereas the outer tube is real made of the non- active cytoplasm.*
























Figure (B) *It is remarkable how the node of Ranvier adapts to meet all the work demands. It takes off its myelin sheath. It absorbs the non-functional cytoplasm. In such a way, its membrane comes into direct contact with the Action Pressure Wave. At the node of Ranvier,*
























the neural fiber recruits the pressure- gated sodium ion channels in large quantities.















[For more details concerning the three Functions of the nodes of Ranvier, see the linked video:](#) 

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In another context, one can also 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 \(Innovated\)](#)*
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-  *[Node of Ranvier The Anatomy](#)*
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-  *[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*](#)
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-  [*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, 1st Hypothesis of Pathophysiology*](#)
-  [*Clonus, 2nd 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*](#)
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-  [*This Woman Can Give Birth to Male Children More Than to Female Children*](#)
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