

Node of Ranvier, Functions & Functional Anatomy "Innovated Conception"

The anatomy of node of Ranvier is well illustrated. However, the function of each anatomical detail 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 node of Ranvier.

The concerned anatomical details are:

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

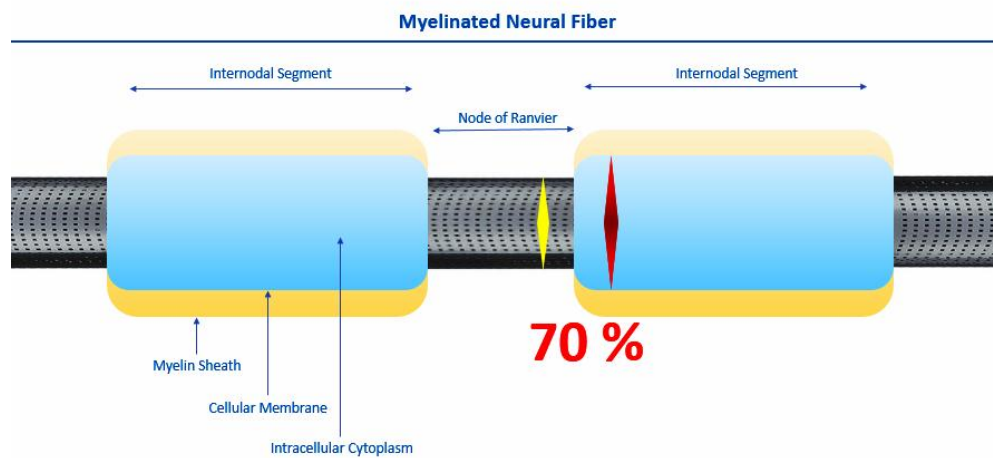


Figure (1)
Node of Ranvier,

is only present in the myelinated neural fiber.

The segments of the neural fiber between two subsequent 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 nodes of Ranvier, the cell membrane is rich of sodium ion channels.

At nodes of Ranvier, the neural fiber loses third of its diameter.

At nodes of Ranvier, the cell membrane is massively supported with the microtubules and the microfilaments.

1- Nodes of Ranvier, The Power Stations

Upon its passage through each node of Ranvier, the tail of action pressure wave is going to be positively charged by the incoming sodium ions. The pressure gated sodium ion channels facilitate the entry of sodium ions Na^+ into the neural fiber. Since, the rest of neural fiber is negatively charged mainly due to the intra cellular proteins, the action potential is built up.

Between the induced positive polarity of the tail of action pressure wave, and the instinctively negative polarity of the distal cytoplasm of neural fiber, an action potential is built up and an action electrical current is fired on as well; *figure (2)*.

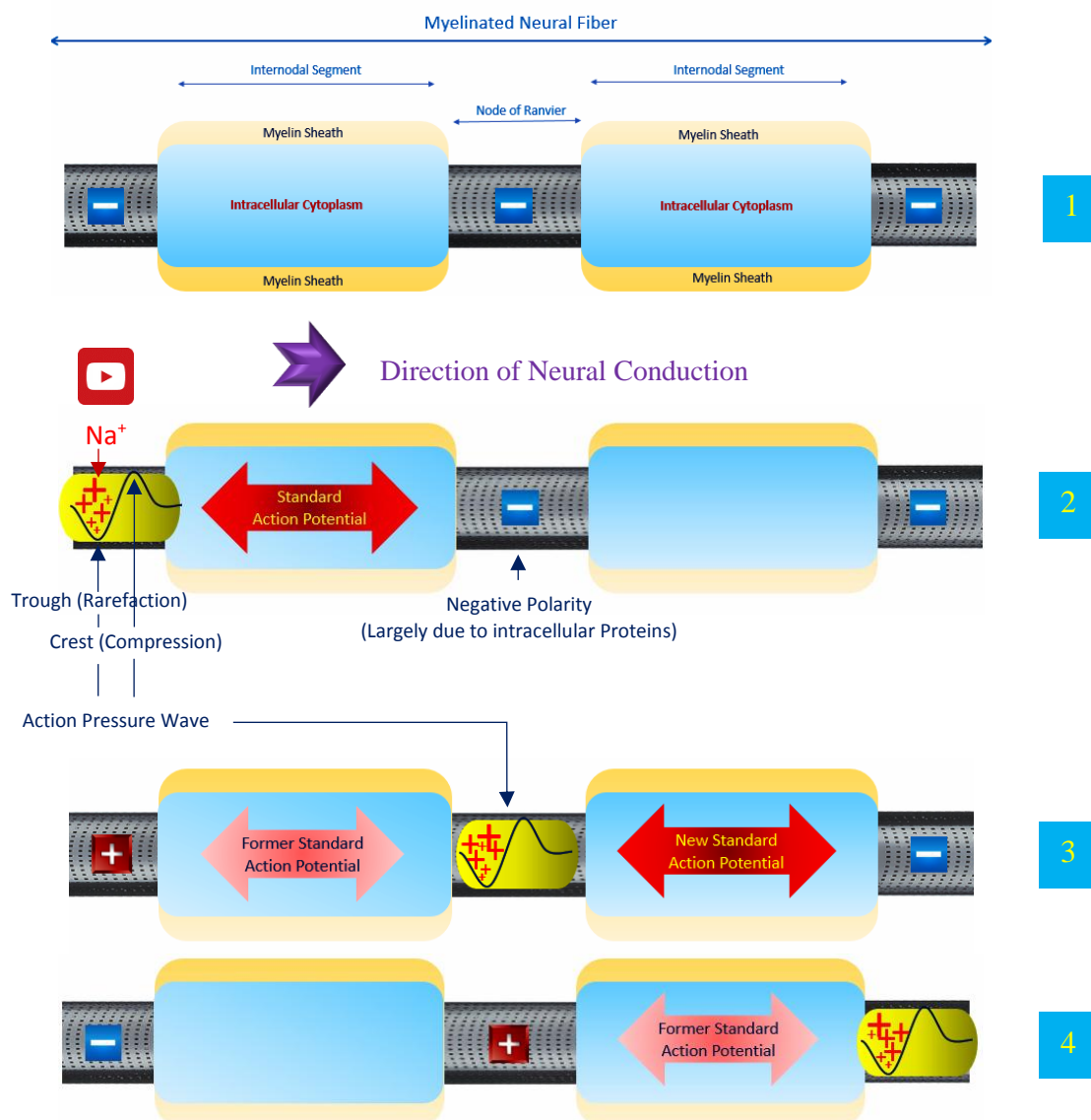


Figure (2)

Node of Ranvier, the Power Station

In motor neurons, the *Action Pressure Wave* is built up at the distal portion of the axon hillock.

It runs on as a single pressure impulse. It 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.

They form together the wavelength of the action pressure wave.

Upon its passage through the nodes of Ranvier,

the negative pressure (rarefaction) of the tail of action pressure wave opens the gates of the 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 built up.

1: at rest. 2 & 3 & 4 during the neural conduction

2- Nodes of Ranvier, The Equalizers

(control the trajectory & the parameters of 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. Nodes of Ranvier keep the action pressure wave in conformity with the standards. The trajectory of the action pressure wave always is 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)*.

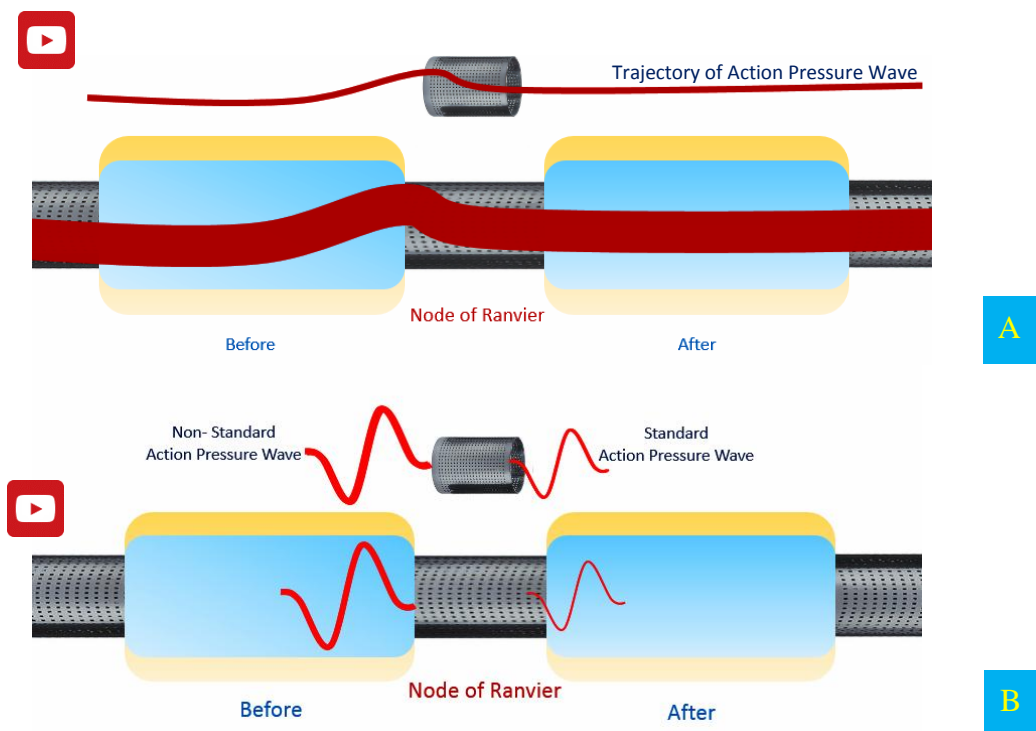


Figure (3)
Node of Ranvier, the Equalizer
Control of Wave Trajectory and Wave Parameters

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


Figure (B) at birth, the action pressure wave may use almost the entire lumen of the first segment of neural fiber. Hence, it comes in direct contact with the cell membrane. If it continues like that along the neural fiber, it may harm the cellular elements. Repeated such aberrant action presssure waves could damage the whole process of neural conduction.

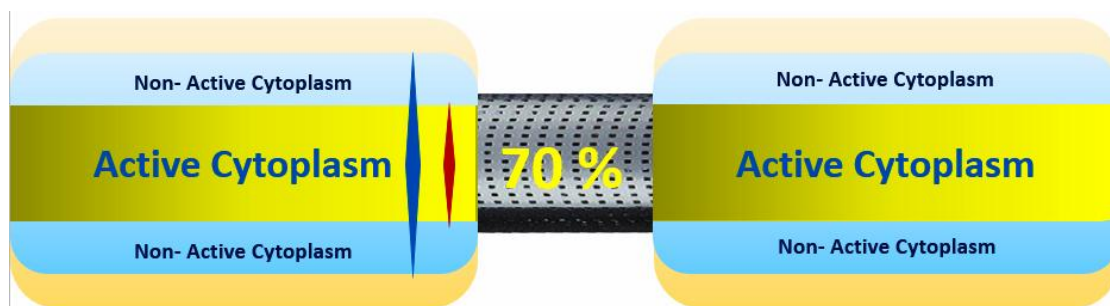
Furthermore, somewhere of its course, the action pressure wave may surpass the standards of energy and velocity. In such cases, the suivant node of ranvier will correct the wave's parameters and oblige the aberrant action pressure wave to respect the standards again, and so do the suivant nodes along the neural fiber.

3-The Anatomical Adaptations

For its optimal function, the anatomy of node of Ranvier must permit a direct contact between the action pressure wave and the extracellular space. Hence, the negative pressure of the tail of the action pressure wave can apply direct influence on the gates of 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 node of Ranvier. The anatomical adaptations at node of Ranvier are as follow:

- 1- It loses its myelin sheath. Myelin sheath is the barrier that prevents sucking the extracellular sodium ions into the fiber's lumen by the sucking force of the trough of action pressure wave. The incoming sodium ions are indispensable to build up the positive pole of the standard action potential. In turn, the standard action potential optimizes the trajectory of the imminent coming action pressure wave and hence accelerating its passage throughout the concerning internodal segment. (*For more details, watch the related 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 internodal 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 neural fiber against the harmful effects of the 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.



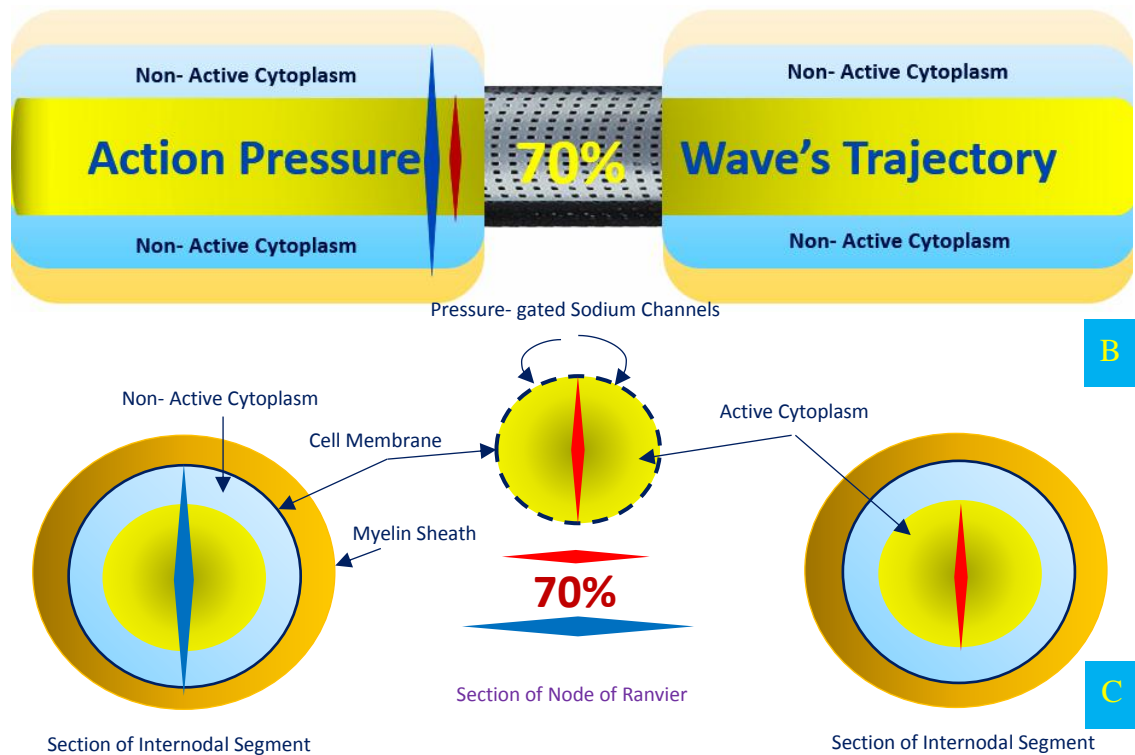






Figure (4)
Node of Ranvier,
The Functional Anatomy

The action pressure waves use the central sector of the cytoplasm of neural fiber. I named this part of cytoplasm in use the functional cytoplasm. and I named the peripheral sector of cytoplasm out of use the non-functional cytoplasm. In internodal segments, the functional cytoplasm is surrounded by the non-functional cytoplasm. However, in 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) & (B) the action pressure wave uses the central sector of the neural fiber cytoplasm. 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 (C) 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-active 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.

In another context, one can read:

- [*Neural Conduction, Personal View vs. International View \(Innovated\)*](#)
-  [*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*](#)
-  [*Neural Conduction in the Synapse \(Innovated\)*](#)
-  [*Sensory Receptors*](#)
- [*Nodes of Ranvier, the Equalizers \(Innovated\)*](#)
-  [*Nodes of Ranvier, the Functions \(Innovated\)*](#)
-  [*Nodes of Ranvier, Function N1 \(Innovated\)*](#)
-  [*Nodes of Ranvier, Function N2 \(Innovated\)*](#)
-  [*Nodes of Ranvier, Function N3 \(Innovated\)*](#)
- [*The Philosophy of Pain, Pain Comes First! \(Innovated\)*](#)
- [*The Philosophy of Form \(Innovated\)*](#)
- [*Spinal Injury, pathology of Spinal Shock, Pathology of Hyperreflexia*](#)
-  [*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 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)

7/8/2018