

WALLERIAN DEGENERATION

The degenerative changes which occur in the part of axon distal to the site of injury are referred to as an anterograde degeneration or Wallerian degeneration (after the discoverer A Waller, 1862).

The degenerative changes occurring in the neuron proximal to the injury are referred to as retrograde degeneration.

These changes take place in the cell body and in the axon proximal to injury.

CHANGES IN THE PART OF AXON DISTAL TO INJURY

The degenerative changes start within few hours of injury and continue for about 3 months and include the following:

Axis cylinder

Axis cylinder becomes swollen and irregular in shape within a few hours of injury. After a few days it breaks up into small fragments, the neurofibrils within it break down into granular debris and seen in the space occupied by axis cylinder.

Myelin sheath shows slow disintegration which starts on eighth day and continues up to 32nd–35th day. In fact, myelin sheath is converted into fat droplets containing cholesterol esters.

Neurilemmal sheath is usually unaffected but the Schwann cells start multiplying rapidly.

Macrophages invade the region and remove degenerating axons, myelin and cellular debris and thus the neurilemmal tube becomes empty.

Schwann cell's cytoplasm proliferates rapidly and fills up the empty neurilemmal tube. These cells produce a large series of membranes that help to form numerous tubes which play a vital role in the regeneration of nerve fibres.

Changes in the cell body of neuron

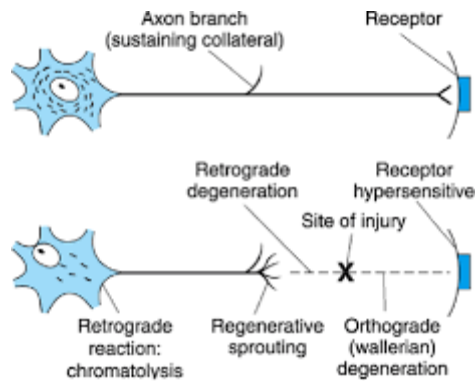
Changes in the cell body of injured neuron start within 48 h and continue up to 15–20 days. The changes are:

Nissl substances undergo disintegration and dissolution (chromatolysis).

Golgi apparatus, mitochondria and neurofibrils are fragmented and eventually disappear.

Cell body draws in more fluid, enlarges and becomes spherical.

Nucleus is displaced to the periphery (towards cell membrane). Sometimes the nucleus is extruded out of the cell, in which case the neuron atrophies and finally disappears completely.



Source: Ganong W.F.: *Review of Medical Physiology*, 22nd Edition:
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STAGE OF REGENERATION

The stage of degeneration is followed by the stage of regeneration under favourable circumstances. It starts within 4 days of injury but becomes more active after 30 days and may take several months to one year for complete recovery.

FACTORS AFFECTING REGENERATION

- _ Regeneration occurs more rapidly when a nerve is crushed than when it is severed and the cut ends are separated.
- _ Chances of regeneration of a cut nerve are considerably increased if the two cut ends are near each other (gap does not exceed 3 mm) and remain in the same line.
- _ Presence of neurilemma is must for regeneration to occur. Therefore, axons in the CNS once degenerated never regenerate as these nerve fibres have no neurilemma.
- _ Presence of nucleus in the neuron cell body is also must for regeneration to occur. If it is extruded, the neuron is atrophied and the regeneration does not occur.