



Nerves and Neuropathy

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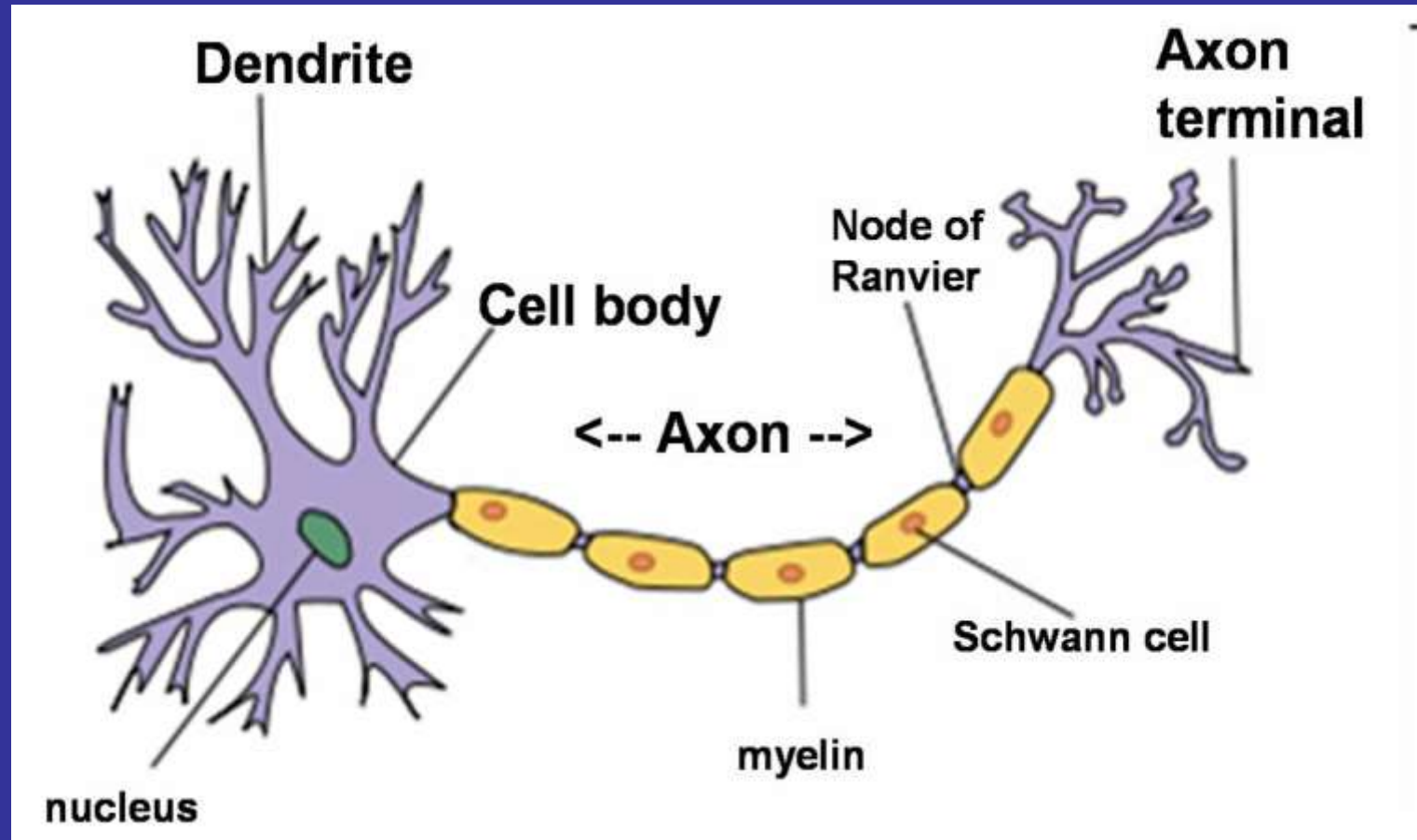
What is a nerve?

- A nerve is a cable-like bundle of axons that runs between the spinal cord and the periphery
- Axons transmit information by an electrical current that runs along the axon like a wire in your home
- The axons are each surrounded by a fatty coating, called myelin, that acts like insulation on a wire

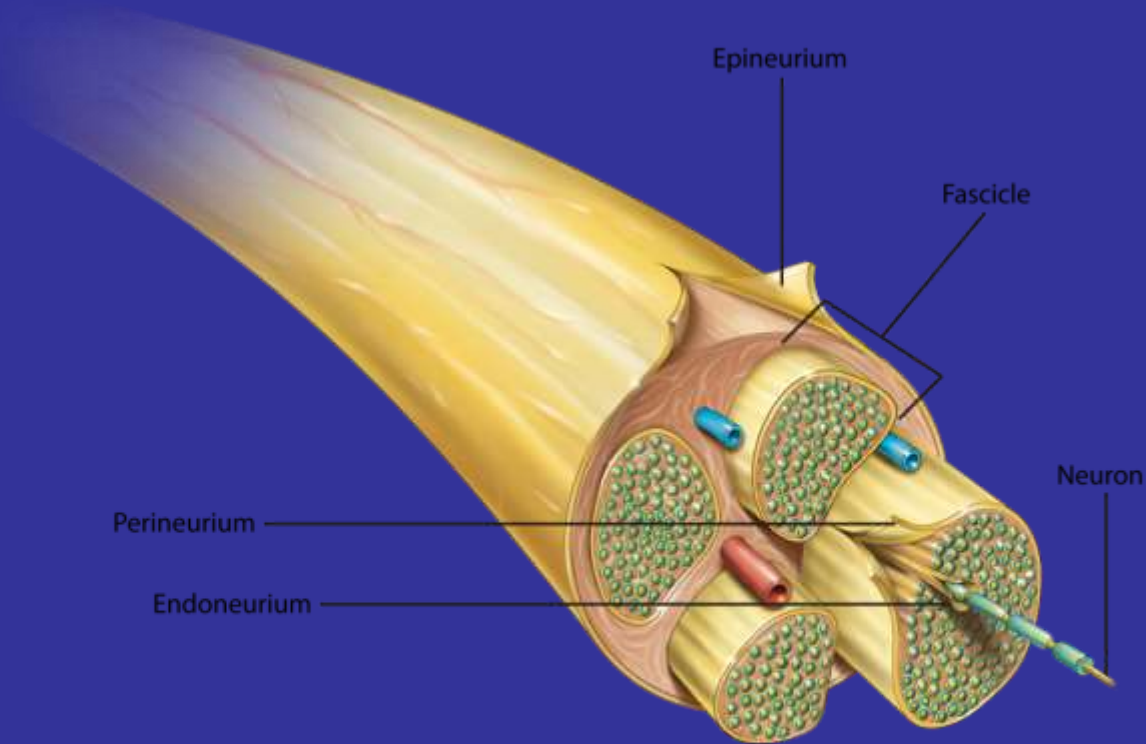
What is an axon?

- An axon is the arm-like extension of a nerve cell (neuron)
- There are motor, sensory and autonomic neurons which send out axons
- The neurons are located in or near the spinal cord

Structure of a neuron

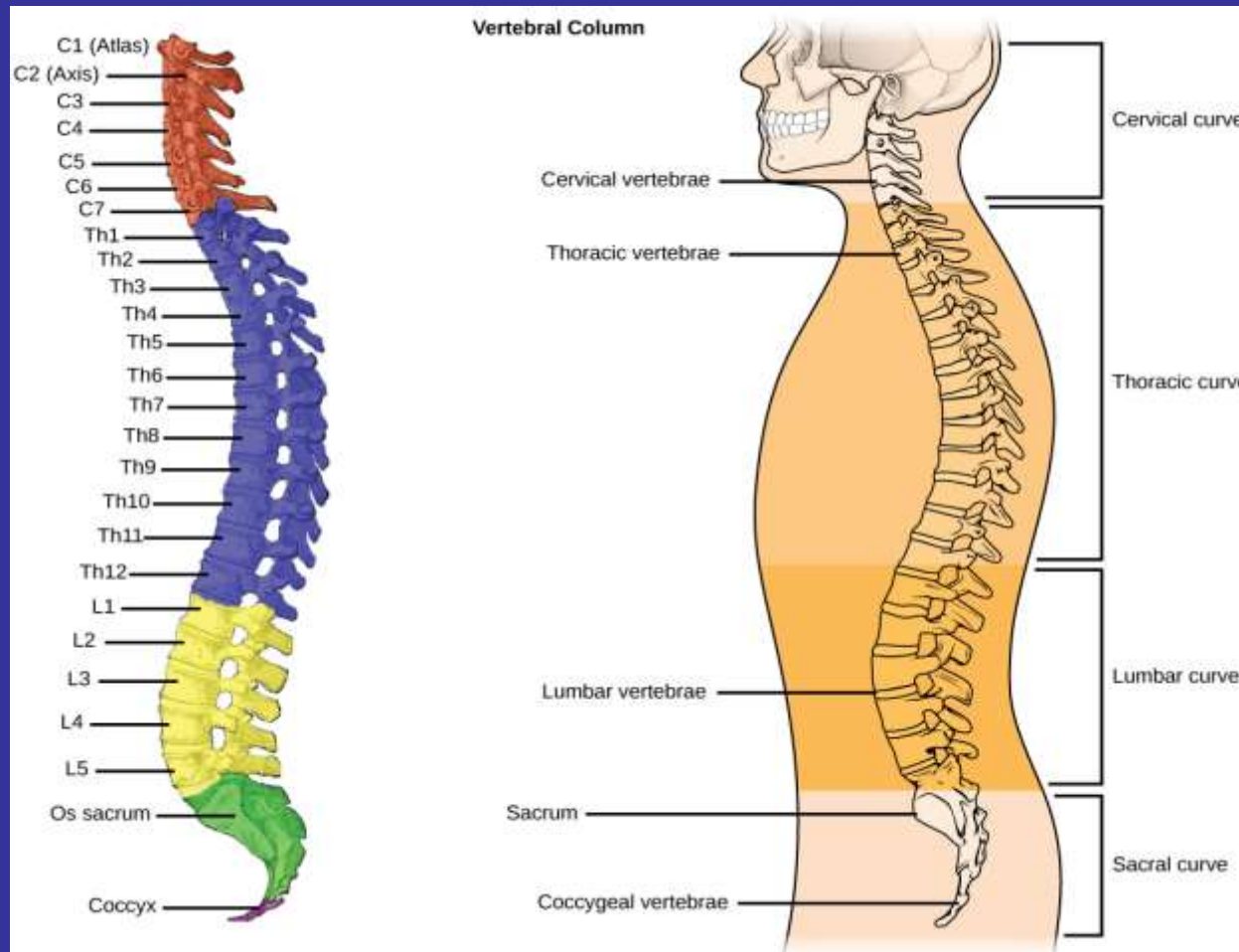


Cross Section of a Nerve



Nerve

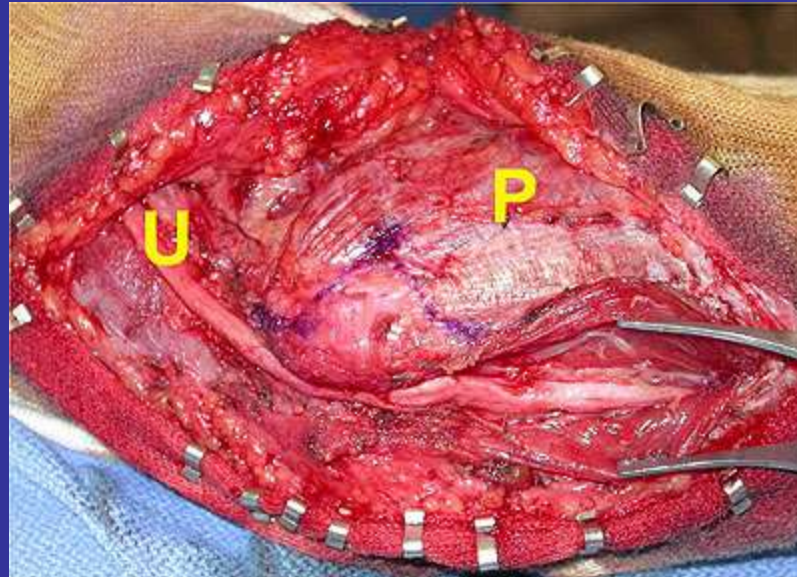
Where do nerves come from?





Thoughtco.com

What do nerves look like?



There are 3 kinds of axons

- Motor – information goes out to muscles
- Sensory – information comes in from skin, joints, muscles, organs etc.
- Autonomic – governs “automatic functions”

Motor Axons

- Motor neurons sit in the spinal cord and send out an axons to contact muscle cells
- When the motor neuron fires an electrical impulse, the impulse races down the axon and the end of the axon releases a chemical, called a neurotransmitter, that causes the muscle cell to contract.

Sensory Axons

- Sensory neurons sit just outside the spinal cord and send one long axon out to the skin and organs and one short axon into the spinal cord
- Sensory axons bring information from the skin and organs to the spinal cord and up to the brain so we can feel, hear, taste, smell, see and know where our limbs are in space.

Autonomic Axons

- The cell bodies that make these axons sit in the spinal cord and brainstem and send out axons that contact
 - Salivary glands in the mouth
 - Tear glands in the eye
 - Muscle in the wall of the stomach and intestine
 - Sweat glands in the skin
 - Muscle in the wall of blood vessels
 - Including those in the genitals

Different axon types are different sizes

- Autonomic axons are the thinnest
- Sensory axons
 - Thinnest mediate pain and temperature
 - Thickest mediate pressure, vibration and joint position sense
- Motor axons are the thickest with the thickest myelin coat

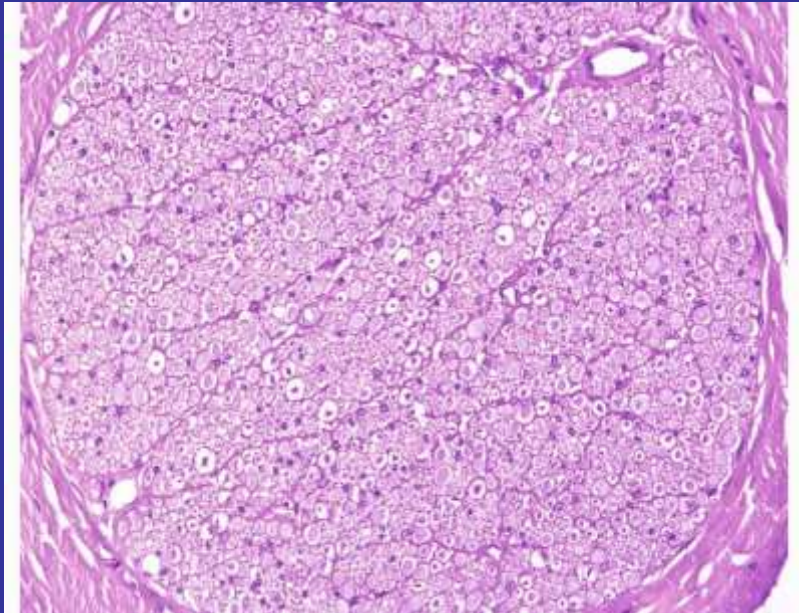
Nerve Damage in Amyloidosis

- Can be one nerve
 - Carpal tunnel syndrome
- Can be nerve roots as they emerge from the spine
 - Radiculopathy (“pinched nerve”)
- Can be generalized disorder of nerves
 - Polyneuropathy = peripheral neuropathy

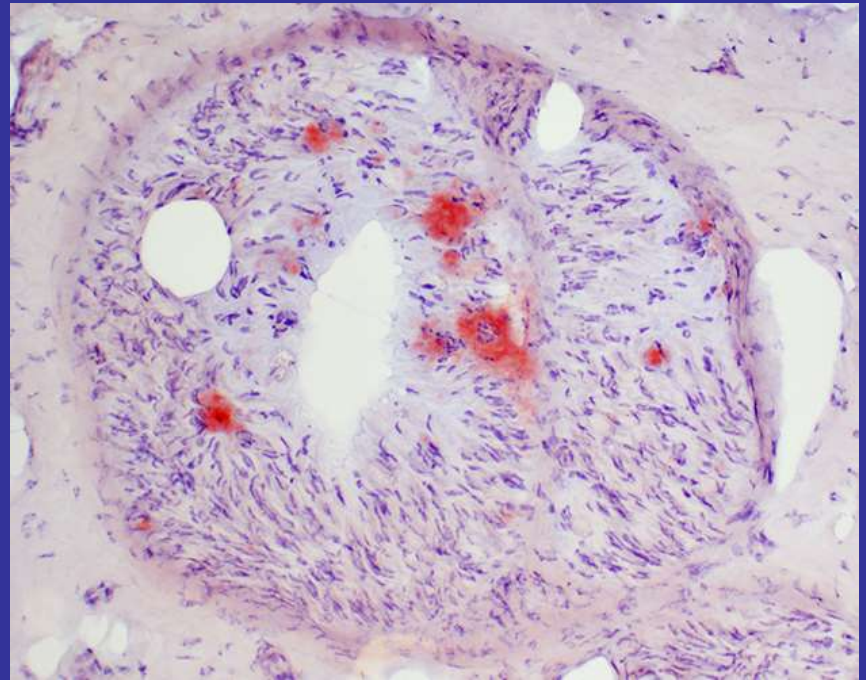
Amyloid Polyneuropathy

- Axonal, length-dependent, symmetrical, dying-back neuropathy
 - Axon itself is damaged by amyloid
 - Compression of axons by amyloid deposits
 - Amyloid compresses blood vessels that supply nerves
 - Metabolic component
 - Longest nerves affected first – why?
 - Thinnest axons affected first, thicker axons are affected later
 - Symmetrical
 - The nerve degenerates from the end, upward

Normal nerve



Nerve with amyloid



Symptoms of Polyneuropathy

Sensory Symptoms

- Tingling, numbness, burning, feeling cold, feeling like walking on cotton/something in your shoe
- Feeling off-balance when closing your eyes
- Start in feet, slowly climbs up the legs. When the symptoms are at knee level may have symptoms in the hands
- Often feel worse at night
 - Off your feet, no pressure from walking

Sensory Symptoms

- Why does it feel numb and painful at the same time?
 - Different axons mediate different sensations
 - Thin axons mediate pain sensation
 - When damaged, they fire – brain “feels” it as pain
 - Thick axons mediate touch and pressure sensation
 - When damaged, do not transmit information to the brain – so brain does not “feel” touch

Motor Symptoms

- Weakness
 - Starts in feet
 - Weakness in hands
 - Think about carpal tunnel syndrome
- Atrophy of muscle
- Cramps
- Restless legs

Autonomic Symptoms

- Dry eyes and mouth
 - Nerves to the lacrimal and salivary glands are damaged
- Trouble accommodating to bright light
 - Autonomic nerves control constriction of the pupil
- Lightheadedness when standing
 - Autonomic nerves make your blood vessels constrict and your heart rate increase when you stand up
- Skin and nail changes
 - Shiny, dry skin with hair loss
- Diarrhea/constipation
- Erectile dysfunction in both the penis and clitoris
- Decreased vaginal lubrication

Treatment of Polyneuropathy

- Questions people ask
 - Is my underlying disease being treated?
 - Is there treatment to make nerves grow back?
 - How do I treat symptoms?
- Then I ask – Do you want treatment?
 - Is it making you crazy?

If I am treated will my nerves grow back?

- Maybe
- Nerves regrow best in people who are young and otherwise healthy
- Nerves grow back slowly
 - 1 mm a day = 1 inch a month = 1 foot a year

Can I treat the numbness?

- While pain and tingling can be treated, there is no treatment for the numbness
- Tincture of time

Symptomatic treatment of sensory symptoms

- Without Medication
 - Foot rub or warm water foot massage before bed
 - Acupuncture (but check with your doctor regarding risk of infection!!!)
 - Anodyne light therapy and cold laser
 - Increase blood flow and make feet feel better – expensive
 - Use of compression socks
 - Transcutaneous nerve stimulation
 - May or may not help, can be done at home
 - Percutaneous nerve stimulation
 - Some literature supports this
 - Done in the office

Symptomatic treatment of sensory symptoms

- Topical Medication
 - Lidoderm cream or patch – topical anesthetic
 - Aspirin-like creams (diclofenac)
 - Menthol cream (Ex. Ben Gay)
 - Capsaicin cream
 - initially increases pain, must be used 2-4 times/day
 - Capsacin patch (Qutenza and generic)
- Botulinum toxin injected into the top of the feet in a grid

Symptomatic Treatment Medication

- Anti-seizure medications
 - Lyrica (pre-gabalin)
 - Neurontin (gabapentin)
- Antidepressants
 - Cymbalta (duloxetine)
 - “tricyclic antidepressants” like Elavil (amitriptyline) – not typically used in amyloid
- Anti-inflammatory
 - Aspirin-like drugs
 - Tylenol
- Long acting narcotics are usually not appropriate for the treatment of nerve pain.

What about marijuana?

- There are studies that show benefit of smoked cannabis for pain in diabetic and HIV associated neuropathy
- Fewer studies addressing oral cannabis
- No good data about CBD oil (topical or oral)
- Must take cognitive side effects into account
- Legal in some states, not in others

Treatment of cramps

- Amazingly, no one really knows why people get muscle cramps
 - Associated with electrolyte abnormalities like salt, calcium and magnesium
- Amazingly, there are not great treatments for muscle cramps
 - Stay well hydrated
 - Stretch muscles for 10 minutes before bed
 - Magnesium supplement (250 mg/day)
 - Check with your doctor first!
 - Bar of soap under sheets?
 - FDA warning against using quinine

Treatment of Restless Legs

- Check iron level and supplement if low
- Stretching the legs before bed
- Warm or cool packs
- Regular exercise
- Cut out caffeine for a few weeks
- Relaxation techniques before bed
- Sleep hygiene
 - Regular bedtime
 - Cool dark room
 - No screens for 2 hour before bed

Medications for RLS

- Ropinirole (Requip), rotigotine (Neupro) and pramipexole (Mirapex) are approved by the FDA for RLS. These medicines are also used for Parkinson's Disease
- Gabapentin (Neurontin) and pre-gabalin (Lyrica) may help and have fewer side effects
- Short-acting, Valium-like drugs such as clonazepam (Klonopin) may help but are addictive

Treatment of motor symptoms

- No medication to help with strength
- Physical therapy
- Assistive devices

Treatment of Autonomic Symptoms

- Dry eyes
 - Artificial tears during the day and lacrilube at night
- Dry mouth
 - Biotene and Xylimelt products
- Skin changes
 - Moisturizer

Treatment of Autonomic Symptoms

- Low blood pressure
 - Decrease or discontinue high blood pressure medications with your doctor's advice
 - Stay as well hydrated as your heart can handle
 - Sit-up and stand-up slowly
 - Compression stockings – must be thigh high!
 - Medications
 - Midodrine (ProAmatine)
 - Fludrocortisone (Florinef)
 - Droxidopa (Northera)

Treatment of autonomic symptoms

- Early satiety
 - Small, low fat meals
 - Metoclopramide (Reglan)
- Diarrhea
 - Lomotil and Imodium are over-the-counter
 - Talk to your doctor
 - Tincture of opium
- Constipation
 - Many OTC laxatives
 - Osmotic (miralax, prunes, bran cereal)
 - Stimulant (Dulcolax)
 - Linzess by prescription

Treatment of autonomic symptoms

- Erectile dysfunction (men and women)
 - Take it slow
 - Viagra-like medications
 - Require some nerve function to work
 - Other treatments can be discussed with a urologist
- Decreased vaginal lubrication
 - Take it slow
 - Vaginal lotions
 - Estrogen supplements

Things advertised on the Internet

- Private Neuropathy clinics
- Alpha-lipoic acid
 - Lowers blood sugar
- Neuracel and other pills
 - FDA forbidden from regulating supplements

- This thing:
 - \$700.00

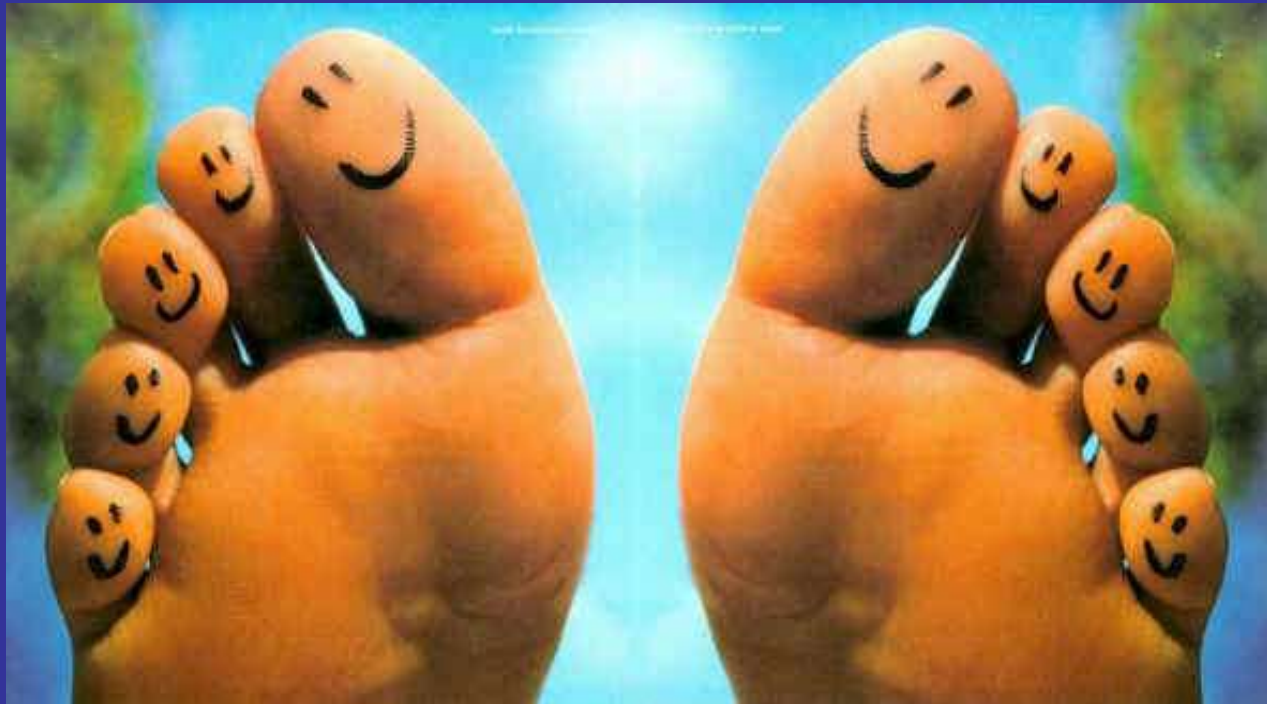


NEUROPATHY TREATABLE?



FIND OUT WHAT YOUR PEERS VOTED AS THEIR #1 SUPPLEMENT TO HELP REDUCE NEUROPATHY PAINS...

[WATCH VIDEO SUCCESS STORIES HERE...](#)



A word about foot care

- If you can't feel your feet you can't feel cuts or sores that can become infected.
- Foot care tips
 - Look between and under your toes every day
 - Wear soft, well fitting shoes
 - Do not walk barefoot, particularly outside
 - Keep feet soft and well moisturized
 - Have nails filed rather than cut
 - A podiatrist or specialized pedicurist can help
 - Don't cut your own nails
- Neuropathy leads to decreased blood flow, and decreased antibiotic delivery, to the feet
- We want you have all 10 toes, all of the time!

Lifestyle changes

- Exercise is good
 - You don't hurt the nerves with exercise
- Sex – yes
- Sleep
 - A good night's sleep makes the next day easier
- Healthy eating

What you can do for healthy nerves

1. CUT DOWN ON ALCOHOL – IT IS DIRECTLY TOXIC TO NERVES
2. STOP SMOKING – WITH EVERY PUFF YOU CAUSE CONSTRICTION OF THE BLOOD VESSELS THAT NOURISH NERVES
3. EAT A LOT OF FRUITS AND VEGETABLES, ESPECIALLY DARK GREEN LEAFY VEGETABLES WHICH CONTAIN B VITAMINS (but not if you are taking warfarin)
4. MUSCLES DEPEND ON THEIR NERVE SUPPLY TO STAY HEALTHY – USE THEM BOTH

Resources

- Healthy Nerves pamphlet on ASG website
- Boston University Amyloid Treatment and Research Website
 - Podcasts
 - Healthy Nerves pamphlet

<http://www.bu.edu/amyloid/resources/patient-resources/>

AND a new book: *Peripheral Neuropathy: What It Is and What You Can Do To Feel Better*

A word about wtATTR

- With age wtATTR deposits in a variety of tissues
 - Heart (Heart failure with nl EF, 13%. aortic stenosis surgery 16%)
 - Ligamentum flavum of the spine (lumbar spine stenosis, 50%)
 - Biceps tendon (rupture)
 - Flexor retinaculum of the wrist (CTS)

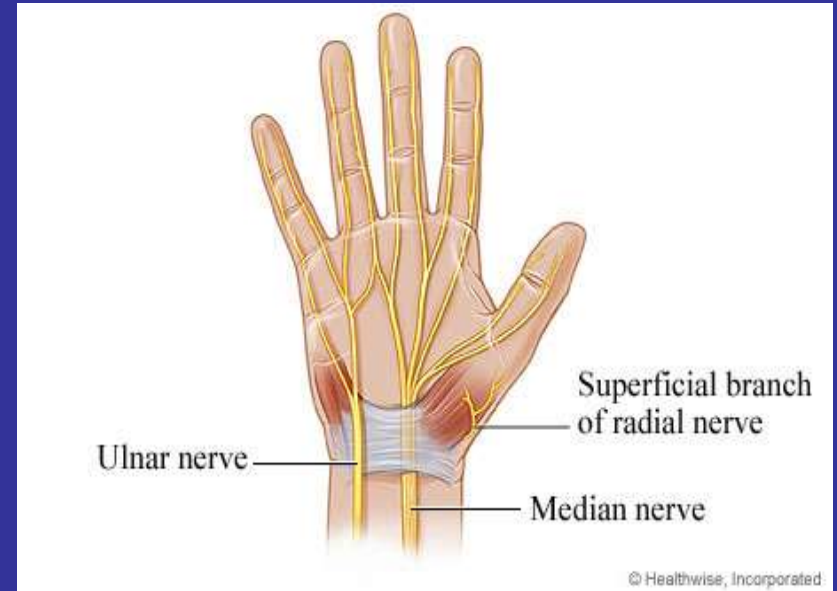
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Carpal Tunnel Syndrome

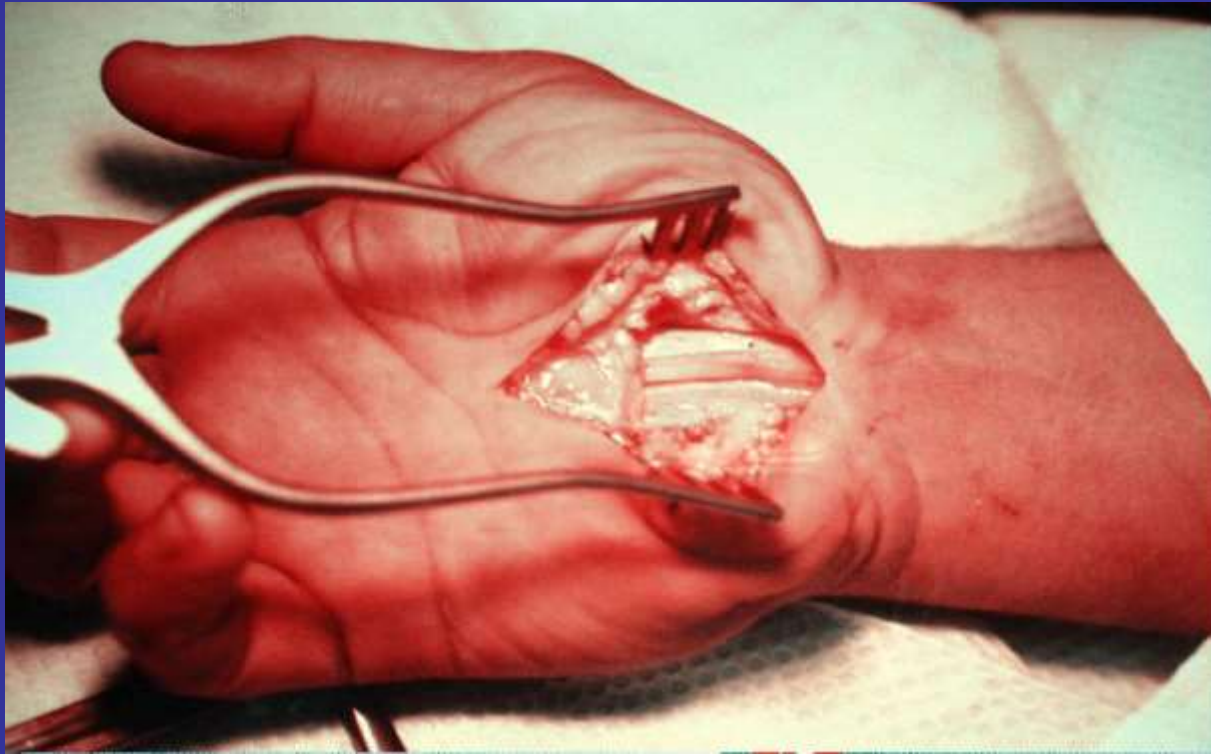


www.carpal-tunnel-syndrome.com



webMD

Carpal Tunnel Syndrome

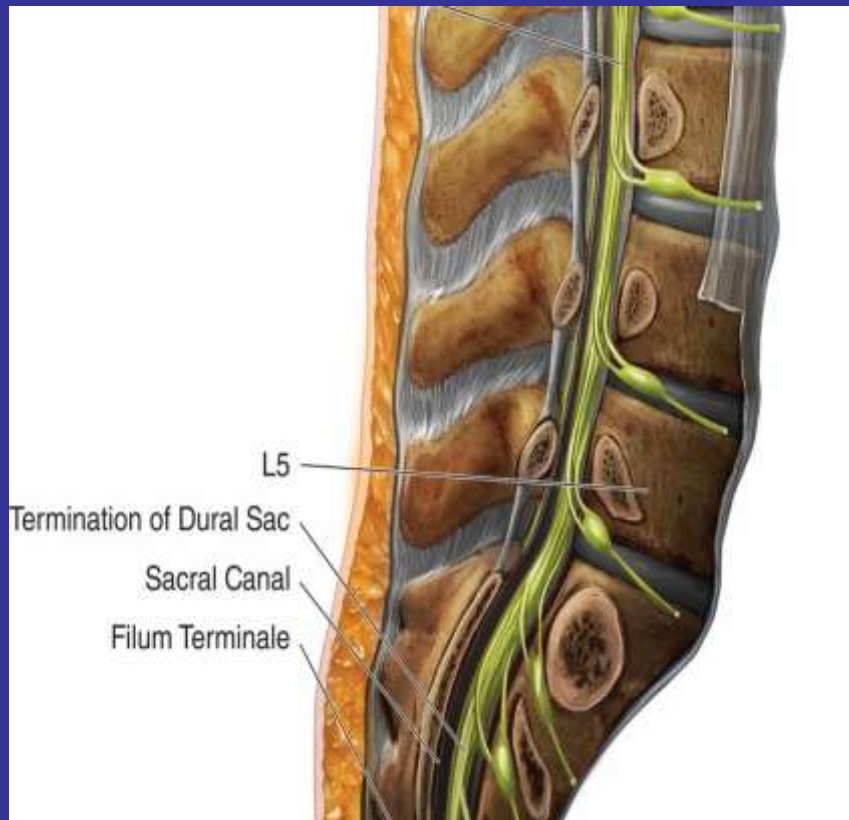


wikipedia

CTS Study – Does amyloid in the wrist predict amyloid in the heart?

- 98 people having CT release
- Average age 68 (M>50, F>60)
- 10 had biopsy + mass spect positive for amyloid
 - 7 with TTR (2 mutations, 5 wild type)
 - 2 AL
 - 1 Untyped
- All 10 with positive bx had bilateral CTS
(but 83% of those with negative biopsy also had bilateral disease)
- 2/10 had cardiac involvement (1 AL, 1 wt-TTR)

Lumbar spinal stenosis



Amyloid and lumbar spine stenosis

- Looked at 26 people having surgery for lumbar spine stenosis and stained tissue
- 25/26 had positive staining for amyloid
- Of the 25 biopsies, 15 were typed
 - Of the 15, 4 showed TTR wild type and the rest were a mixture of more than one type of amyloid