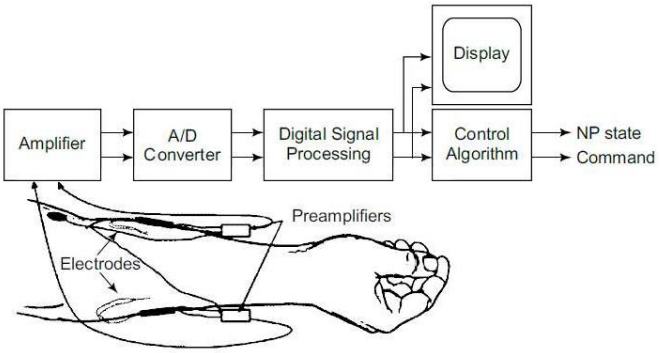
ELECTROMYOGRAPH(EMG)

- Electromyograph is an instrument used for recording the electrical activity of the muscles to determine whether the muscle is contracting or not; or for displaying the action potentials spontaneously present in a muscle in visual and audible form or those induced by voluntary contractions as a means of detecting the nature and location of motor unit lesions; or for recordingthe electrical activity evoked in a muscle by the stimulation of its nerve.
- The instrument is useful for making a study of several aspects of neuromuscular function, neuromuscular condition, extent of nerve lesion, reflex responses etc.
- EMG measurements are also important for the myoelectric control of prosthetic devices(artificial limbs). This use involves picking up EMG signals from the muscles at the terminated nerve endingsof the remaining limb and using the signals to activate a mechanical arm. This is the most demanding requirement from an EMG since on it depends the working of the prosthetic device.
- EMG is usually recorded by using surface electrodes or more often by using needle electrodes, which are inserted directly into the muscle. The surface electrodes may be disposable, adhesivetypes or the ones which can be used repeatedly.
- A ground electrode is necessary for providing a common reference for measurement. These electrodes pick up the potentials produced by the contracting muscle fibres. The signal can then be amplified and displayed on the screen of a cathode ray tube. It is also applied to an audio-amplifier connected to a loudspeaker. A trained EMG interpreter can diagnose various muscular disorders by listening to the sounds produced when the muscle potentials are fed to the loudspeaker. The stagesof data acquisition and signal processing in an electromyograph.
- The myoelectric signals are amplified with the use of preamplifiers and a differential amplifier together having an effective passband of 10 to 1,000 Hz. The signals are sampled at 5 kHz with 16-bit analog-to-digital conversion, rectified, and smoothed with a running time window average witha window length of 240 ms that is updated every 80 ms.
- The processed signals are normalized by the amplitudes of the maximum voluntary contractionsandare displayed on a computer monitor. The waveforms can be stored to facilitate playbackand studyof the EMG waveforms at a later convenient time. The waveform can also be printedas a hard copy for records.



➤ Fig. 5.20 *Block diagram of a typical set-up for EMG recording*

- Modern day EMG machines invariably use digital signal processing techniques.
- Analog- to- digital converters (ADC) are used to convert the amplified differential signals into digital signals that are further processed by a microprocessor or a PC. The quality of an EMG signalis therefore largely dependent on the resolution, accuracy and sampling rate of the ADC used.

➤ Fig. 5.21 *PC based digital EMG recording system*

- Modern EMG machines are PC based available both in console as well as laptop models. They provide full colour waveform display, automatic cursors for marking and making measurements anda keyboard for access to convenient and important test controls.
- The system usually incorporates facilities for recording of the EMG and evoked potentials. The stimulators are software controlled. For report generation in the hard copy form, popular laser printers can be used.
- EMG equipment to have a range of new features and networking capabilities.

- The RS-232 serial data transfer protocol previously used in the PC-based systems is now replaced By theUniversal Serial Bus 2.0 which provides faster data exchange rates and even a means of supply power to the EMG had held device to recharge the device.
- Increased storage capacity of data recordings on digital storage media has become a common place.
- EMG equipment to provide the user with extended mobility from the PC on PC-based systems. Acquired EMG signals can now be picked up on the body and sent wirelessly to a PC where itis recorded, processed and analysed.

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Nerve Simulator

Electrical nerve stimulation is an option for individuals who have unsuccessfully tried other pain management options. It is especially useful for those who experience failed back surgery, complex regional pain syndrome, seizures or multiple sclerosis.

Nerve stimulators can be a useful option when chronic pain doesn't respond to physical therapy, medication or surgery.

Types of Nerve Simulator

- Transcutaneous electrical nerve stimulation (TENS)
- peripheral nerve stimulation (PNS)
- spinal cord stimulation (SCS)

Transcutaneous electrical nerve simulation

- Transcutaneous electrical nerve stimulation (TENS) is a therapy that uses low voltage electrical current to provide pain relief. A TENS unit consists of a battery-powered device that delivers electrical impulses through electrodes placed on the surface of your skin. The electrodes are placed at or near nerves where the pain is located or at trigger points.
- There are two theories about how transcutaneous electrical nerve stimulation (TENS) works.
- One theory is that the electric current stimulates nerve cells that block the transmission of pain signals, modifying your perception of pain.
- The other theory is that nerve stimulation raises the level of endorphins, which are the body's natural pain-killing chemical. The endorphins then block the perception of pain.
- TENS therapy has been used or is being studied to relieve both chronic (long lasting) and acute (short-term) pain.

Pain Control Theory

- Gate Control theory : Electrically stimulating sensory nerve receptors, a gate mechanism is closed in a segment of the spinal cord, preventing pain carrying messages from reactive the brain & Blocking the perception
- Endorphin Release theory: Electrical impulse stimulate the production of endorphin and enkaphalins in the body. These natural, morphine – like substance block pain messages from reaching brain.

Two types of current waveform

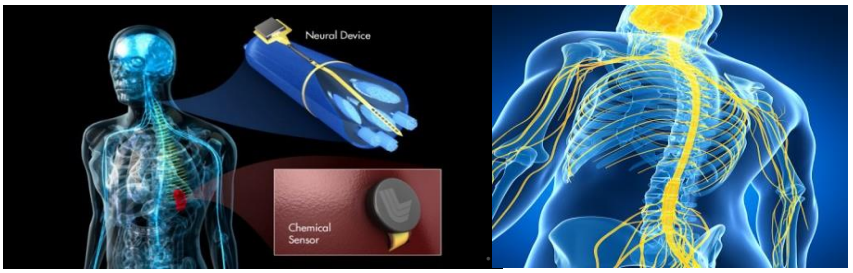
- Square
- Spike wave

Peripheral nerve stimulation (PNS)

- Peripheral nerve stimulation, frequently referred to as PNS, is a commonly used approach to treat chronic pain.
- It involves surgery that places a small electrical device (a wire-like electrode) next to one of the

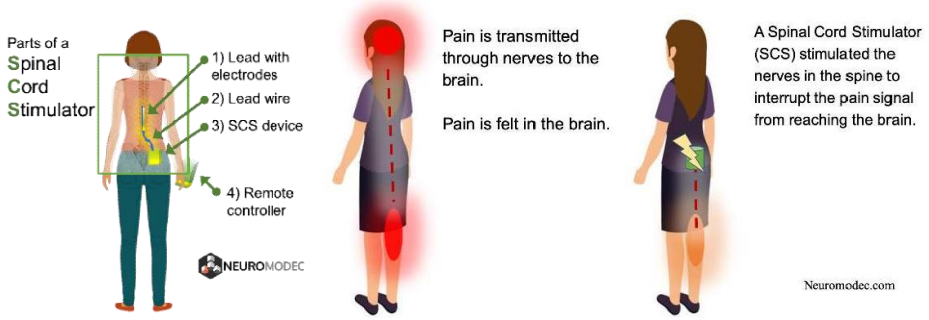
peripheral nerves. (These are the nerves that are located beyond the brain or spinal cord). The electrode delivers rapid electrical pulses that are felt like mild tingles (so-called paresthesias).

- During the testing period (trial), the electrode is connected to an external device, and if the trial is successful, a small generator gets implanted into the patient's body. Similar to heart pacemakers, electricity is delivered from the generator to the nerve or nerves using one or several electrodes.
- The patient is able to control stimulation by turning the device on and off and adjusting stimulation parameters as needed



Spinal cord stimulation (SCS)

- A spinal cord stimulator (SCS) device is surgically placed under your skin and sends a mild electric current to your spinal cord.
- The spinal cord device consists of a pulse generator, a small wire that carries the current from a pulse generator to the nerve fibers of the spinal cord.
- When turned on, the SCS stimulates the nerves in the area where your pain is felt. Pain is reduced when the electrical pulses modify and mask the pain signal from reaching your brain.
- SCS therapy is designed to help treat chronic, ongoing pain.



Spinal cord stimulation is a therapy that masks pain signals before they reach the brain. A small device, similar to a pacemaker, is implanted in the body to deliver electrical pulses to the spinal cord.It helps people better manage their chronic pain symptoms and decrease the use of opioid medications.It may be an option if you suffer chronic back, leg or arm pain and have not found relief with other therapies.