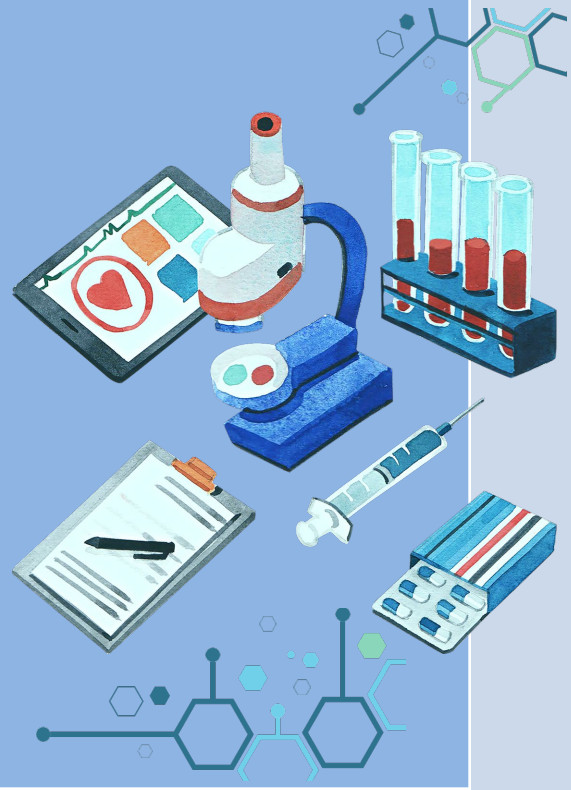
Tishk International University

Faculty of Applied Science

Department of Anesthesia

Radiotherapy And Physiotherapy



Fall Semester

Course Name : Biophysics

Stage : First

Prof. Dr. Fatiheea F Hassan

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Radiotherapy, or radiation therapy, uses high-energy radiation (like X-rays, gamma rays, protons) to kill cancer cells or slow their growth by damaging their DNA, a common cancer treatment used alone or with surgery/chemo to cure cancer, shrink tumors, or relieve symptoms, with side effects varying by treated area but often including fatigue and skin changes.

Types of radiotherapy

External Beam Radiation: Radiation comes from a machine outside the body (linear accelerator).

Internal Radiation (Brachytherapy): Radioactive material is placed inside the body near the cancer.

Systemic Radiation: A radioactive substance travels through the blood (e.g., radiolabeled antibodies).

Types of External Beam Radiation Therapy

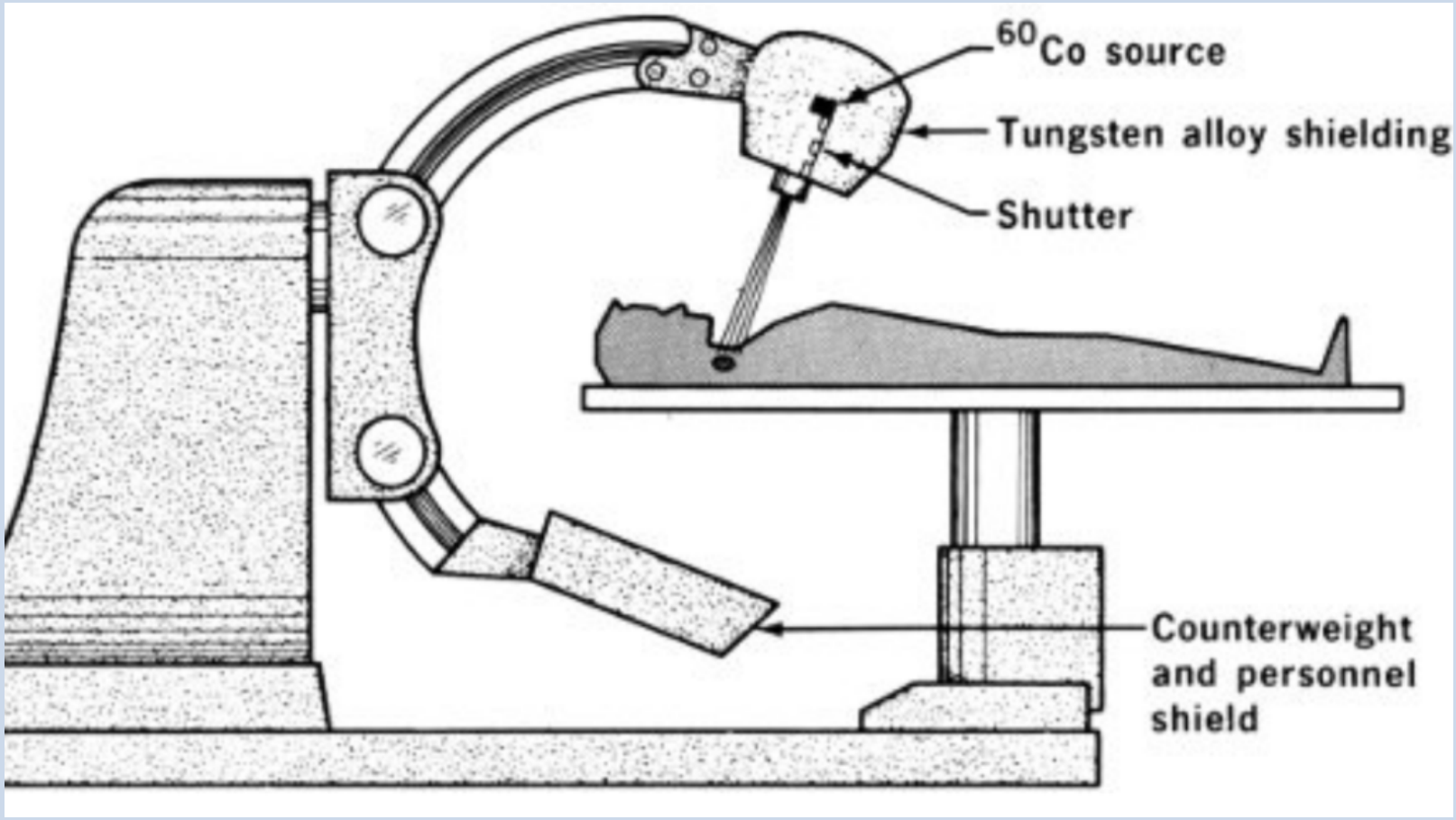
Cobalt therapy is a Gamma Rays emitted from Cobalt 60 machine

Two-dimensional radiation therapy

Three-dimensional conformal radiation therapy (3-D CRT)

Intensity modulated radiation therapy (IMRT)

Volumetric Modulated Arc Therapy VAMAT


^{60}Co source
Tungsten alloy shielding
Shutter
Counterweight and personnel shield

A machine called a linear accelerator, or linac, creates the radiation beam for x-ray or photon radiation therapy.

Radiotherapy involves a three-step process:-

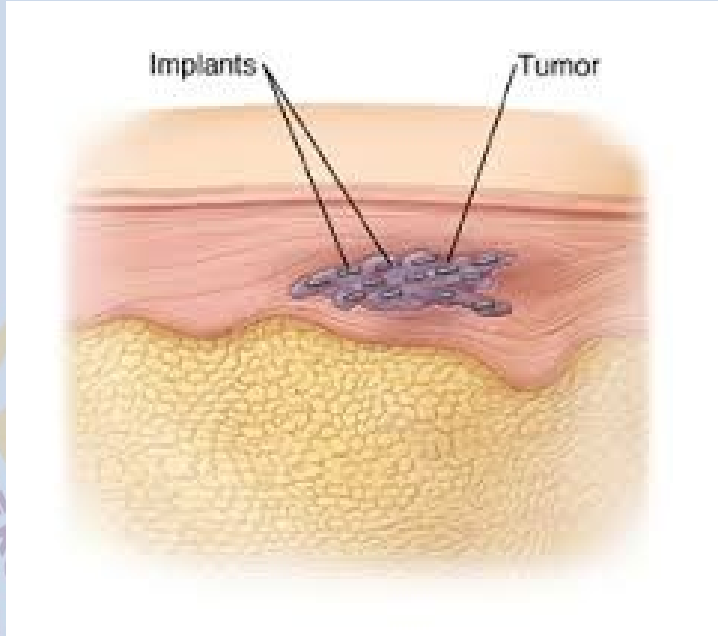
1-Simulation

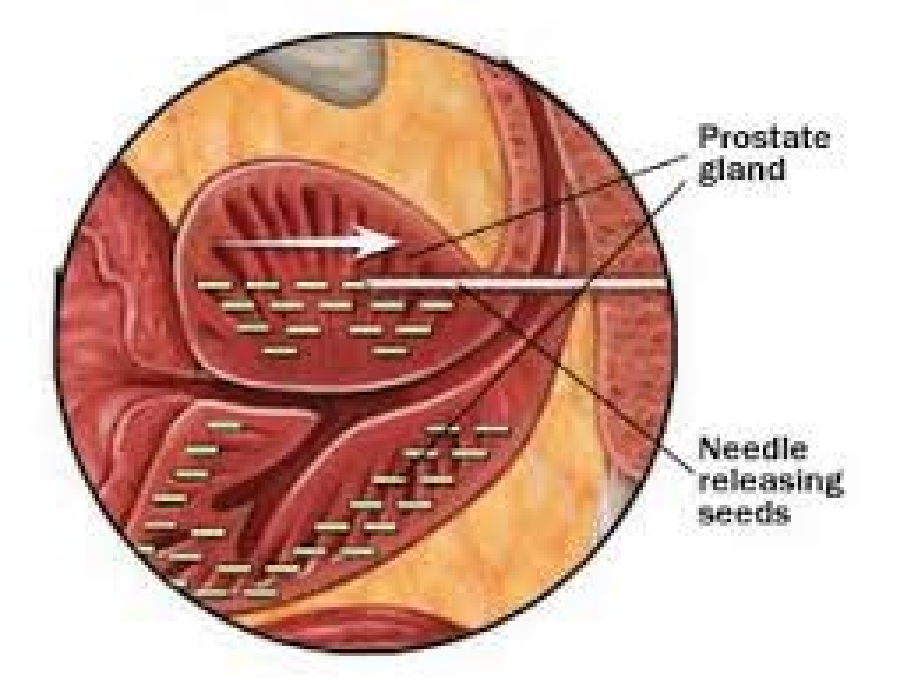
2- Planning

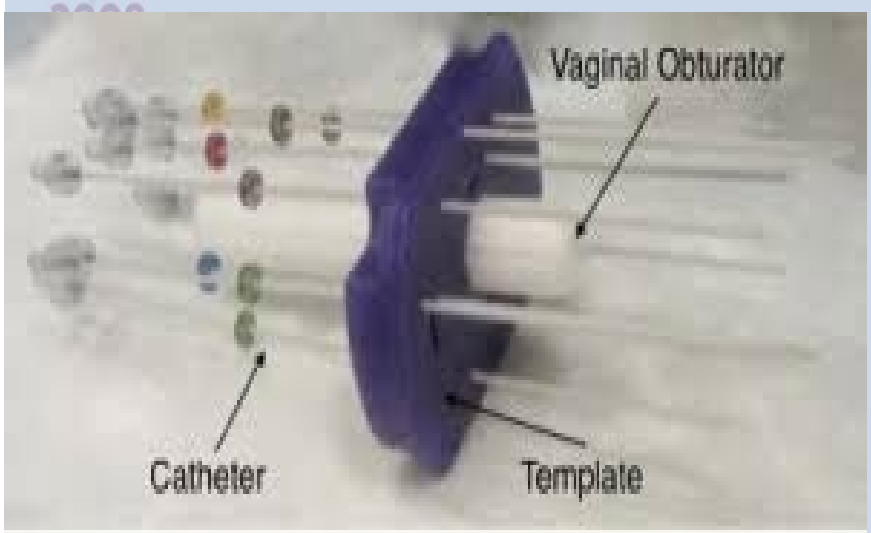
3- And treatment—designed to deliver precise radiation to tumors while sparing healthy tissue.

Brachytherapy

Brachytherapy is a type of internal radiation therapy that treats cancer by placing radioactive sources (like seeds, ribbons, or capsules) directly inside or next to a tumor, delivering a high dose of targeted radiation while sparing healthy tissue.







Principles of Radiotherapy

1. Delivering of an optimal dose to the tumor

2. Minimal damage of surrounding organs & tissues.

Physiotherapy
Heat therapy

Heat was recognized as therapeutic agent several thousand years ago. It has two primary therapeutic effects.

1. An increase in blood supply
2. An increase in metabolism resulting in relaxation of the blood capillaries, and then to cool down the heated area.

Heat production for therapy

1 – The conductive method:

Heat can transfer by conduction, the quantity of heat transfer depends on the temperature difference, the time of contact, the area of contact, and the thermal conductivity of the materials.

This can be done by several ways such as hot bath, hot packs and electric heating pad. This can lead to local surface heating .

2- Radiant Heat:

Heat radiation can be achieved by using infrared (IR) radiation. It penetrates about 3mm in the skin. It can be produce by glowing coils and by 250Watts incandescent lamps. The wavelengths used are between (800-4000nm). An excessive exposure can cause erythematic, sometimes swelling (edema) longer exposure cane cause skin browning or hardening. It is considered to be more effective than conductive heating because it can penetrate deeper.

3- Diathermy:

Short wave diathermy: - utilized electromagnetic wave in radio range (~10m) and microwave range (~12cm) short wave diathermy penetrate deep into tissue (more than conductive and radiant).

Different ways in transferring heat into the body in short wave diathermy.

A- The part of the body to be treated is placed between two plates (electrodes) connected with high frequency power supply. The charged particles of the tissue will be attracted to one plate and to the other depending upon the sign of the alternating voltage on the plate. This movement will produce heat (resistive-Joule(is the process by which the passage of an electric current through a conduct)) heating. Fig (4.9).

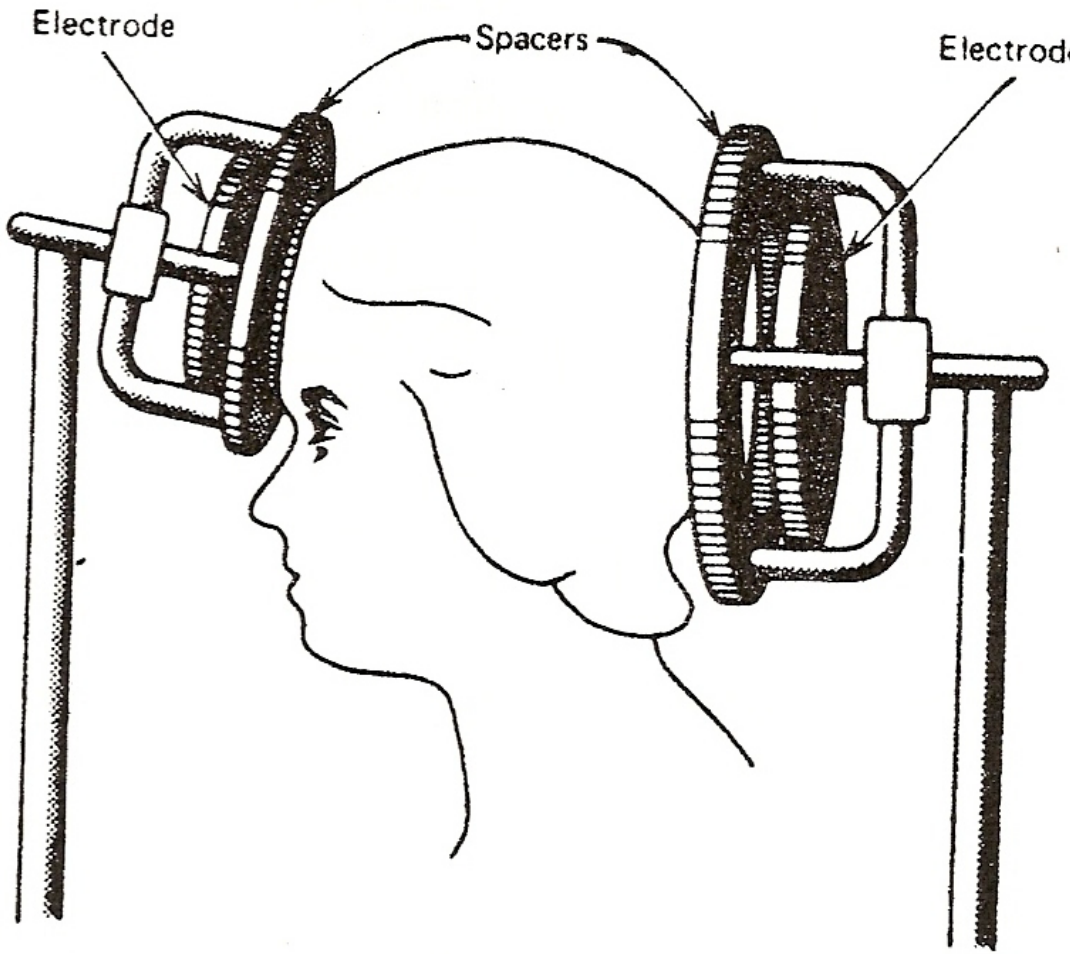


Figure 4.9. Location of capacitor plates for short wave diathermy. (Adapted from Lehmann, J.F.: "Diathermy," *in* Krusen, F.H., Kottke, F.J., and Ellwood, P.M. (Eds.): *Handbook of Physical Medicine and Rehabilitation*, 2nd edition. Philadelphia, W.B. Saunders Company, 1971, p. 286.)

B- By transferring short wave energy into the body by magnetic induction. This can be done either by placing a coil around the region to be treated Fig. (4.10) or by (pancake) coil placed near the part of the body to be treated Fig. (16.5). The alternating current in the coil produces an alternating magnetic field, consequently an alternating eddy currents are induced in the tissue and producing (Joule-heating).

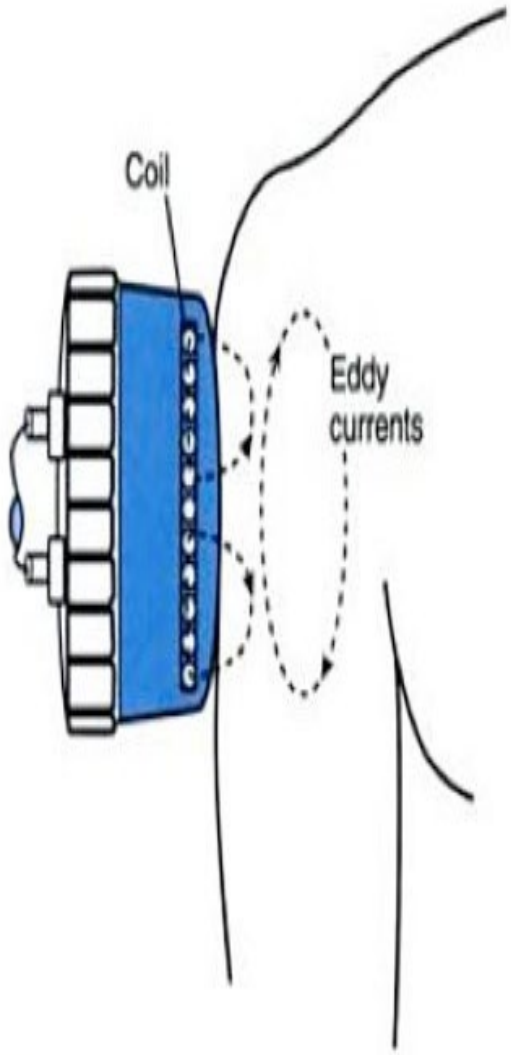


FIGURE 16.5. The magnetic field induced by short wave diathermy creates small eddy currents in the body tissues, resulting in heat.

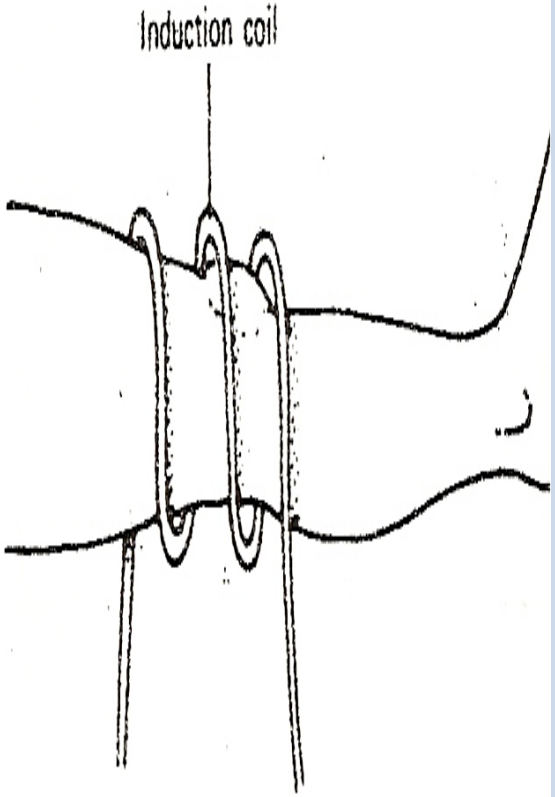


Figure 4.10. Location of induction coil around knee for sho

Short wave diathermy can penetrate deep into tissue. It can be used in relieving muscle spasms, protruded intervertebra discs pain, joints with minimal soft tissue coverage such as knee, elbow.

C-Microwave diathermy:

The microwave diathermy can be produced in special tube called (magnetron) and emitted from the applicator (antenna) which can be placed several inches from the region to be treated. Microwave can penetrate deep into the tissue causing heating. It is used in fractures, sprains, strains, injuries to tendons. The frequency used is 900MHz, which is found more effective than other frequencies in therapy. It causes more uniform heating around bonny regions.

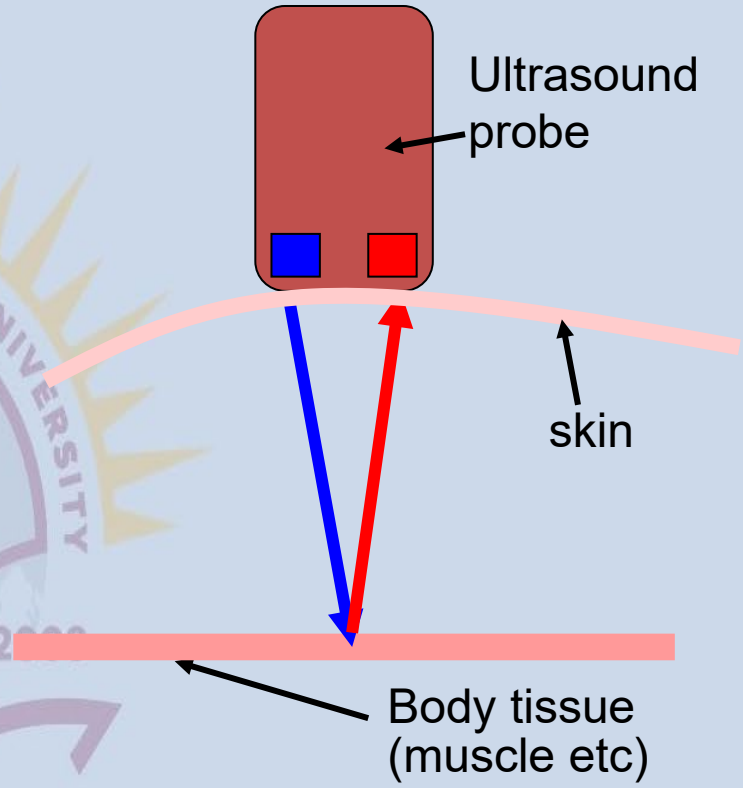
4-Ultrasonic waves:

These waves are different from **electromagnetic waves.** It produces mechanical vibrations inside tissue. It is the same as the sound waves but it has much higher frequencies (about 1MHz) with power of several watts per centimeter. It can move the tissue particles backward and forward with high frequency, in doing so it can increase the kinetic energy consequently it heats the tissue.

Ultrasound can be produced by **special transducers** placed in direct contact with the skin. It is used for relieving tightness and scarring occurring in joint diseases. It can dispose more heat in bones, as bones are better absorber for ultrasonic energy than soft tissue. It is also used in deep therapy.

Pulses of ultrasound are transmitted into the body by placing the vibrating crystal in close contact with the skin using water or a jelly paste to eliminate the air.

This gives a good coupling at the skin and greatly increases the transmission of the ultrasound into the body and of the eachoes back to the detector.



Transcutaneous Electrical Nerve Stimulation (TENS)

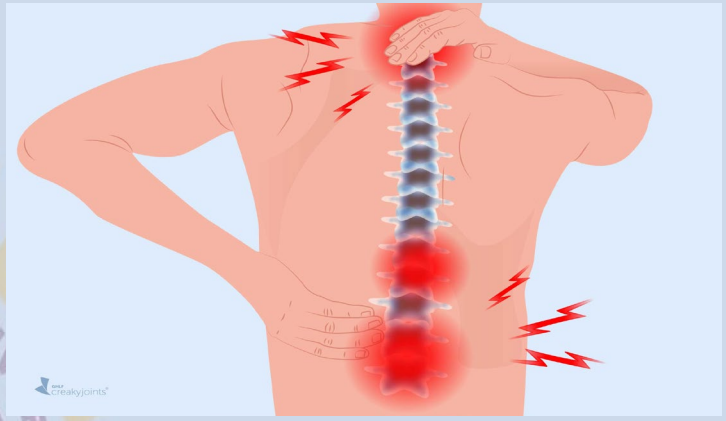
Transcutaneous electrical nerve stimulation (TENS) is a type of pain relief therapy. It uses a low-voltage electrical current to block pain

Transcutaneous electrical nerve stimulation (TENS) :-
is a method of pain relief involving the use of a mild electrical current.

A TENS machine :-
is a small, battery-operated device that has leads connected to sticky pads called electrodes.

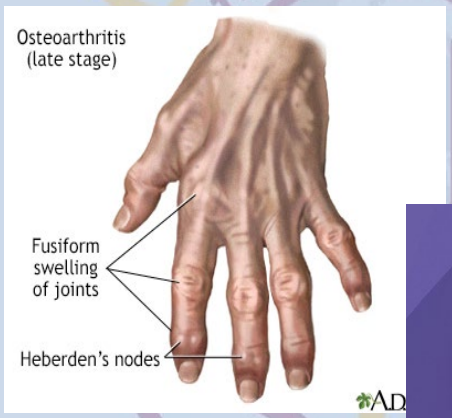
Health conditions treated with TENS

Healthcare providers use transcutaneous electrical nerve stimulation (TENS) to treat a wide range of acute (short-term) and chronic (long-term) conditions such as:



• Back Pain.

•Peripheral artery disease

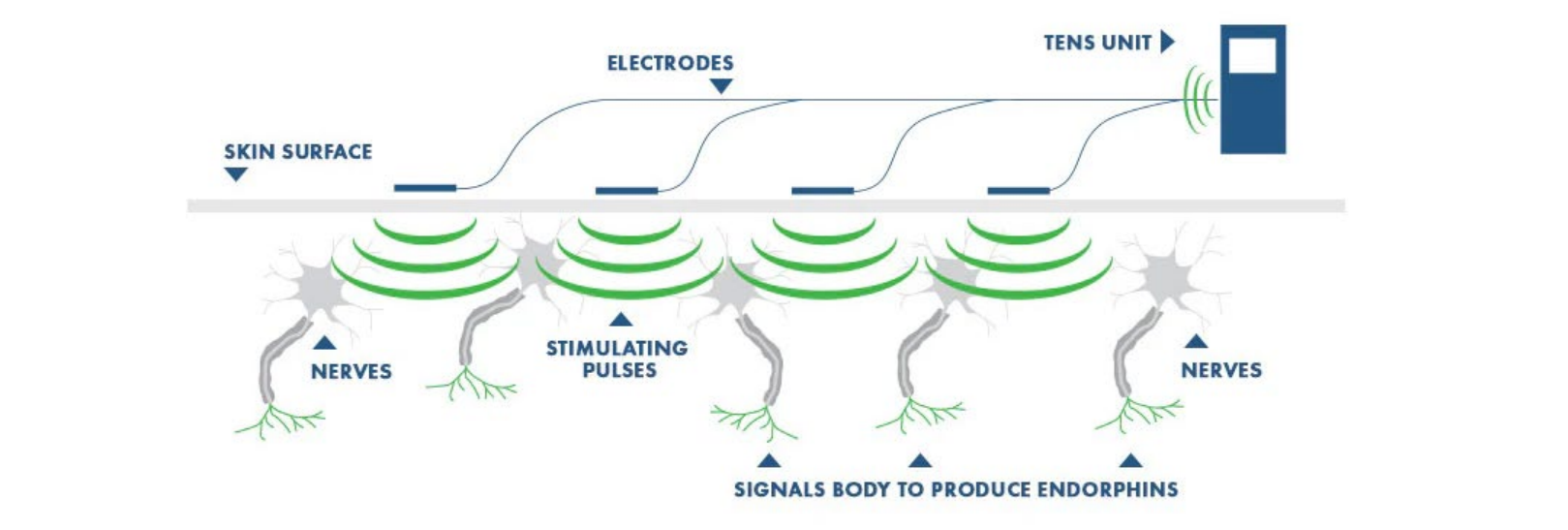


•Osteoarthritis.

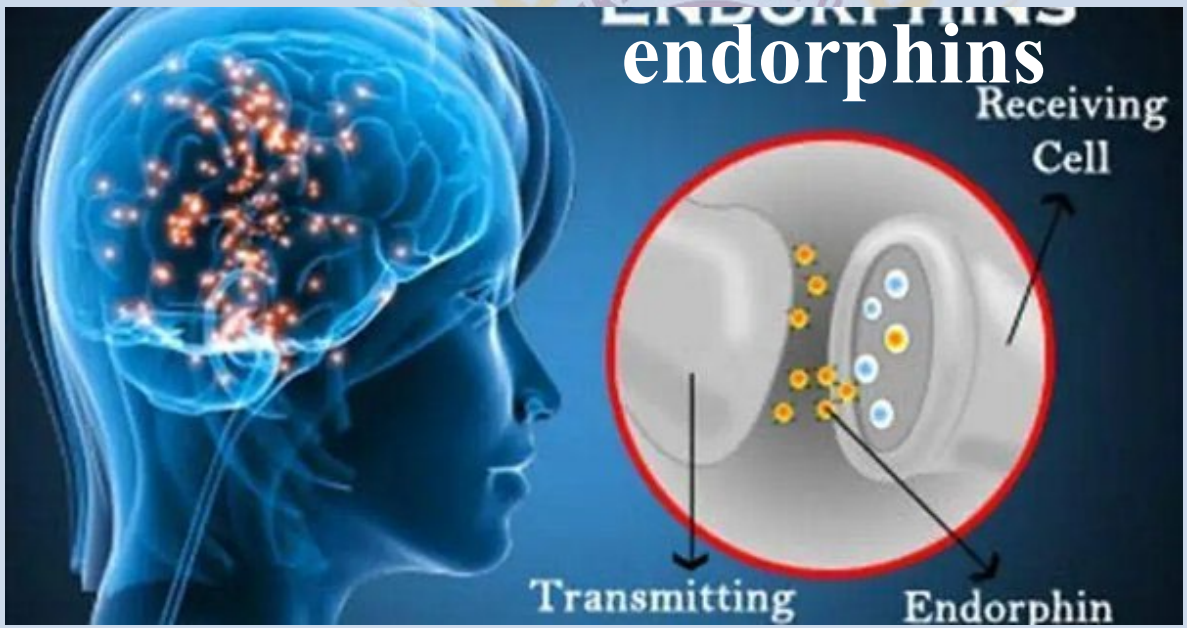
•Chronic pelvic pain.

How does transcutaneous electrical nerve stimulation work?

1.The electrical current stimulates nerve cells that block the transmission of pain signals. This changes the way you perceive pain.



2. The electrical current raises the level of endorphins (Human body's natural pain-killing chemicals.



When can use Heat therapy (physiotherapy tools) before or after exercises ?

Heat therapy (physiotherapy) is used before exercise to increase the elasticity of joint tissues and stimulate blood flow, and then perform the exercises

Why superficial heating do not heat deep tissues,?

Because the subcutaneous layer of fat beneath the skin surface acts as a thermal insulator and inhibits heat transfer.