Traditional Anatomy

- Phrenology, the study of bumps on the skull.
- Measuring brain weights and size (still being done...see the fuss about Einstein’s brain).
- Little link between morphology and performance
- Neanderthal > Homo sapiens
- Hydrocephalic genius

Plane Film X-rays

- Not very good for showing soft tissues
- Can show bone erosion
- Large space filling masses may be picked up if they have largely differing X-ray absorption
- Bone of skull requires high energy for penetration
Contrast Media

CAT with media around cord

Ventriculogram

- Air is introduced into the ventricles via the lumbar cistern (in adults)
- Via the fontanelles in infants
- Patient placed on a tilting table, air fills ventricles
- Can detect "space filling" lesions.
- Causes severe headaches, same dangers as lumbar puncture.

Subtraction Angiography

- Radio opaque medium is introduced into the internal carotid artery or systematically.
- Iodine compounds can promote allergic reactions, any arterial invasion dangerous.
- Subtract X-ray before contrast medium from X-ray with contrast medium.
- Can pick up any abnormality of the blood vessels.
Direct Stimulation

- During operations, surgeons may have to delimit crucial areas.
- Epilepsy often spreads from a temporal lobe focus.
- The speech area on the planum temporale must be identified.
- Cortex stimulated in conscious patient.

Computerised Axial Tomography

- Many X-rays are taken around the head (or body).
- Matching detectors pick up absorbed signal.
- Computer reconstructs a “slice”.
- Axial slices can be reconstructed into 3D pictures.
Magnetic Resonance Imaging 1

- An extremely powerful magnetic field is used to orientate the spin of atoms.
- A radio frequency pulse is used to cause some atoms to flip.
- Energy given off tells a lot about the molecule the atom is in.
- Can also be used to form images.
CAT vs MRI

- MRI (previously known as nuclear magnetic resonance or NMR) is expensive.
- The magnet is supercooled with liquid helium in a liquid nitrogen blanket.
- Exposures are slow.
- No metal may enter the field (no pacemakers etc.).

Ultrasound

- Ultrasound produced by a piezoelectric crystal or array.
- No harm? Local heating and cavitation?
- Doppler effect raises frequency as blood flows towards detector, lowers frequency in the opposite direction.
- Can map blood flow speed.
- Can detect vasospasm (a potentially lethal sequelae to a stroke).

Positron Emission Tomography

- Inject a very short lived (radioactive) isotope with extra proton into the internal carotid.
- Produced in an (adjacent) cyclotron.
- Gives out a positron, leaving a neutron.
- Positron annihilated when it hits and electron.
- Produces two photons in opposite directions.
- Simultaneity detectors record the event.
- Choice of labelled compound determines the result (transmitter etc.)
fMRI

- By targeting protons in hydroxyl groups can measure blood flow
- Areas of high flow = areas of high activity.
- Usual advantages of MRI (see previous slide)
- No radioactivity needed, replacing PET.
Deep Infrared

- New technique
- Involves use of far infrared to penetrate the skull
- Reflected light picked up
- Reflected better by areas of high blood flow
- Experimental, low resolution as yet.

SQUIDS

- Supercooled, quantum interference devices
- Can pick up minute magnetic fields created by the activity of cells.
- More localised than EEGs, not an "average"
- Low resolution as the detectors are large

ERPS
EEGs

- Extra cerebral recordings average all the electrical activity going on in the brain
- Widespread changes can be picked up (epilepsy, coma, REM sleep etc.)

Labelling