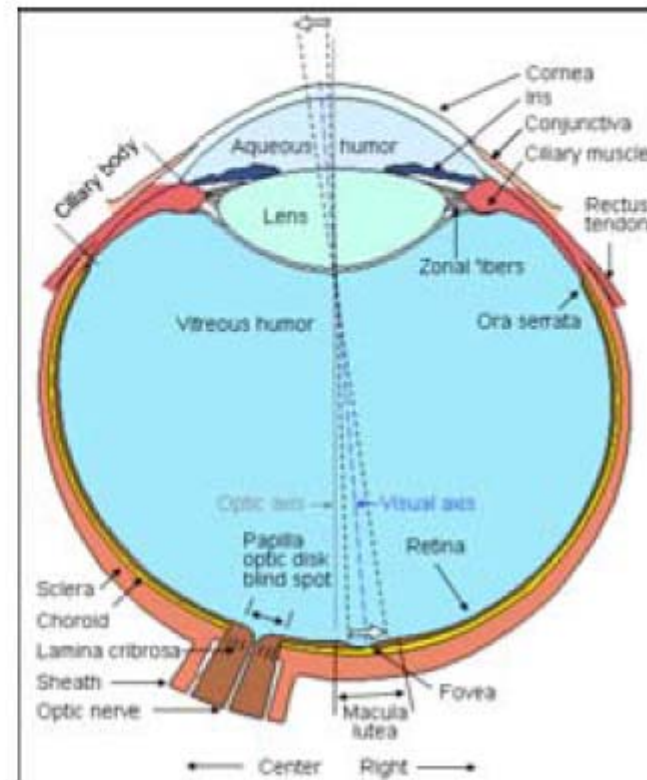


EE 4BD4 Lecture 12

Electro-ocularogram EOG

EOG

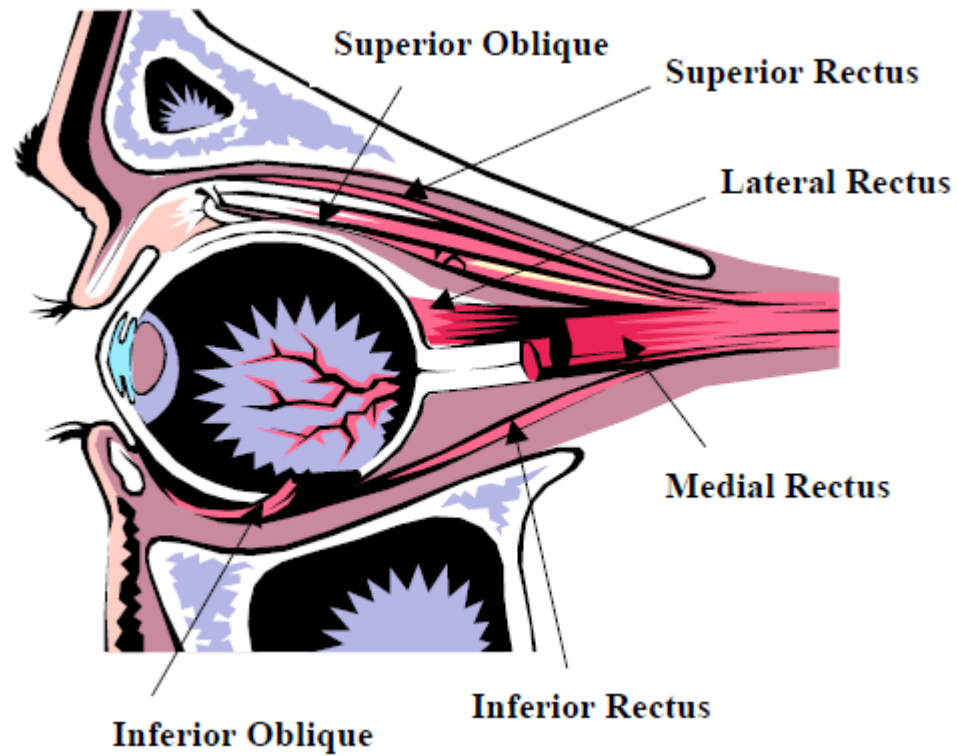
- Emil du Bois-Reymond (1848) observed that the cornea of the eye is electrically positive relative to the back of the eye
- This potential difference is the base for *electro-oculogram*



Other Theories

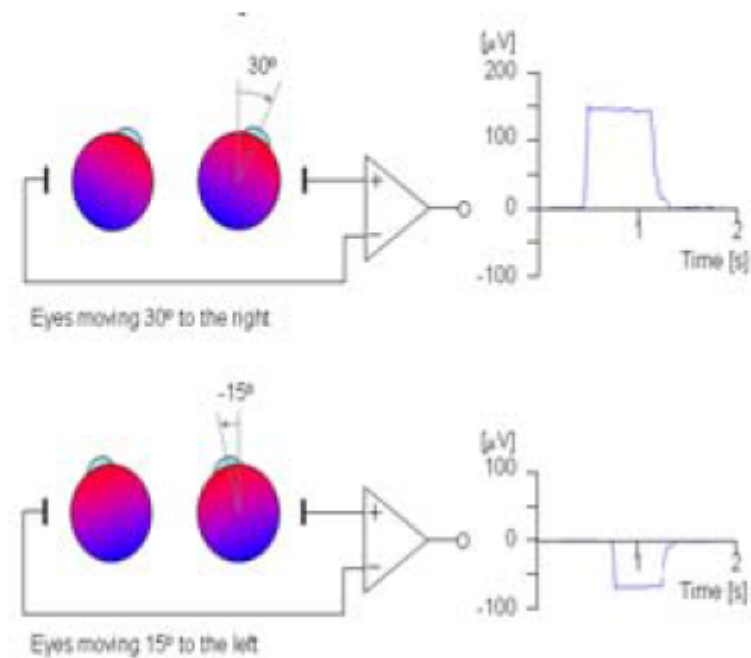
- Dipole is generated by a distribution of positive and negative charges in the retina only
- Signal results from eyelid moving over the eyeball (similar to blink artifact in EEG)
- Not a result of EMG of extra-ocular muscles

Extra-Ocular Muscles



EOG

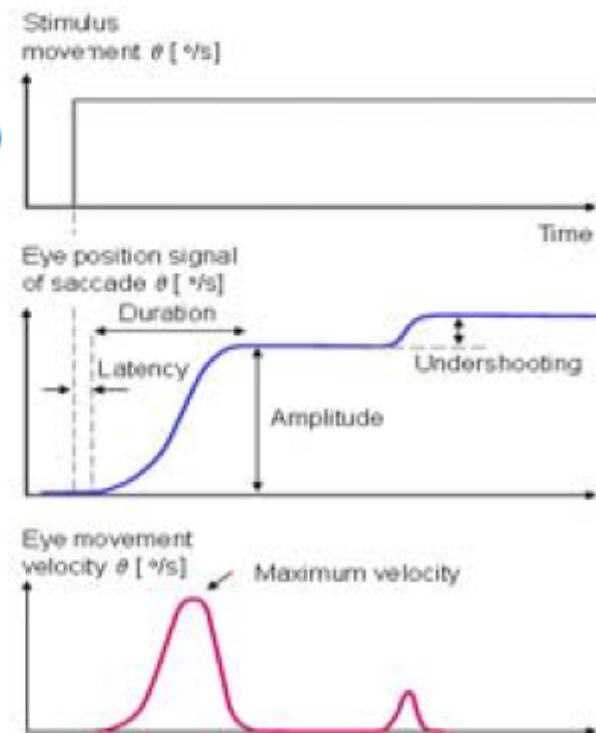
- Amplitude almost linear with angle for up to +/- 30 degrees
- Typical values 5-20 $\mu\text{V}/^\circ$.
- Is a function of illumination



EOG

Saccadic response

- Saccadic movements describe quick jumps of the eye from one fixation point to another.
- Values of interest (can't be voluntarily altered)
 - Maximum angular velocity typ. - $400^\circ/\text{s}$
 - Amplitude - 20°
 - Duration - 80 ms
 - Latency - 200 ms



EOG

Clinical test

- EOG – mainly derived from the retinal pigment epithelium (RPE)
- Changes in response to retinal illumination.
 - decreases for 8–10 min in darkness.
 - subsequent retinal illumination
 - initial fall in the standing potential over 60–75 s (the fast oscillation(FO))
 - followed by a slow rise for 7–14 min (the light response)

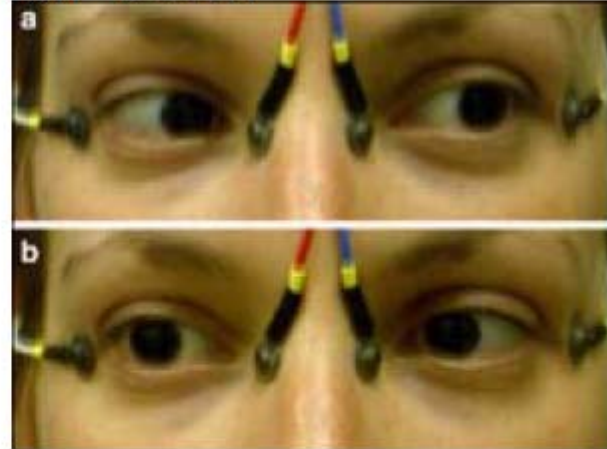
EOG

Clinical test

- clinical (EOG) - indirect measurement of the minimum amplitude of the standing potential in
 - the dark and
 - again at its peak after the light rise.
- This is usually expressed as a ratio of 'light peak to dark trough' - Arden ratio.

EOG - Clinical test

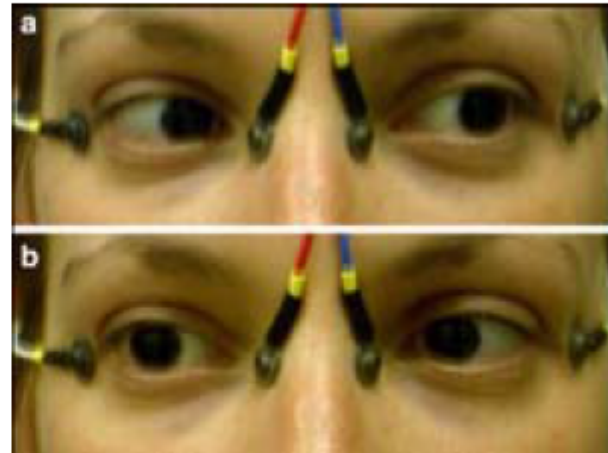
- Electrode placement
 - Ground on the forehead
- Amplifier
 - Differential
 - Signal amplitude 250 and 1000 μV \rightarrow Gain $\sim 1000\times$
 - Freq: 0 – 30Hz
- Full field stimulator
 - two red fixation lights 15 degrees left and right of centre



EOG

Clinical test

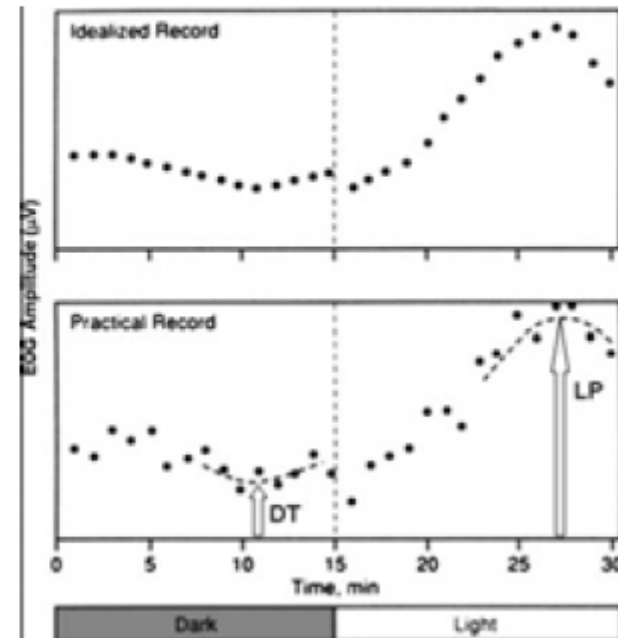
- Procedure - Dark phase
 - In total darkness for 15 min,
 - alternate the fixation lights
 - every 1 s for 10 s every 1 min,
 - record the resulting EOG potentials.
- Light phase
 - Continue recording every 1 min as above.



EOG

Clinical test

- Results
- Arrows
 - dark trough (DT)
 - light peak (LP).
- Arden ratio = (LP/DT)
 - <1.5 abnormally low
 - >2.0 normal
 - otherwise borderline



Utility of EOG

- Help in diagnosis of eye pathologies
- Important data
 - Saccadic movement parameters
 - Arden Ratio
- Identification of REM sleep
- Computer interface for the disabled

Design Considerations

- Electrodes (Ag-AgCl - drift free)
- Bandwidth (filtering)
- What about instrumentation or Op amp voltage offsets?
- AD 620 or LT1920 max voltage offset RTI = 128 μV
- Additional analog circuitry?

Offset Adjust Circuit

