First use of electrical stimulation-
Scribonius Largus
Sacral Neuromodulation

- Electrical current
- Knowledge of anatomy, pathophysiology
Electricity

- Ben Franklin (1707-1790)
- Michael Faraday (1791-1867)
- James Maxwell (1831-1879)
- Thomas A. Edison (1847-1931)
- Heinrich Hertz (1857-1894)
Anatomy and Pathophysiology

- Ludwig Julius Budge (1811-1888) (micturition center S2-4)
- Blaine Nashold (1923-2014) (direct stimulation for micturition)
- C. Norman Shealy (TENS, dorsal primarily pain related)
- G S Brindley (micturition in spinal with sacral anterior root stimulator)
Early stimulation

• Micturition in spinal cord injury
• Chronic pain
Early sacral neuromodulation: UCSF

- Emil Tanagho
- Richard Schmidt
- Udo Jonas
- Homar Bruschini
- J W Thuroff
Early equipment

• Flexon pacer wire
• Inserted through an angiocath type plastic sheath
• Wire taped in place
• Stimulation delivered through a TENS unit
• Change from neurogenic to non-neurogenic patients with “spasticity” symptoms
Initial implants

- Avery labs single channel electrode
- Self powered generators
- Commercialization
- Urosystems
- Medtronic
The biomedical device company Medtronic Inc of Minneapolis, Minnesota, USA, has acquired certain assets of Urosystems Inc of California, USA, with a view to pursuing the treatment of urinary incontinence with implantable electrical stimulation devices. The assets, acquired by the Medtronic's neurological division, include a licence from the University of California and the Urosystems clinical evaluation programme which uses the Medtronic device 'Itrel II' spinal cord stimulation system. This programme is being carried out under an Investigational Device Exemption granted by the US Food and Drug Administration in August 1988.

Researchers from Urosystems and from the University of California at San Francisco have developed techniques designed to treat what is known as urge incontinence and dysfunctional voiding.
Medtronic MDT-103

- PNE (in office- sensory and motor responses, no fluoroscopy)
- Implant- Interstim (after open electrode placement, patient was moved from prone to supine position, re-prepped and re-draped and lead extension tunneled with IPG being placed under rectus in abdomen)
Innovation

• Switch to upper buttock placement during early part of study (decreased infection rates, operating time etc.)
Innovation

- Tined lead
- No need for large cut-down
- Decreased OR time
- Much quicker easier recovery
- Smaller Interstim 2 IPG
Innovation-
Staged implant technique

• Stage I
  – placement of a permanent tined lead connected to an external stimulator
  – test period of 1–2 weeks
  – OR-based (sedation or general anesthesia)

• Stage II
  – Implantation of implantable pulse generator (IPG) unit in OR
Staged Procedure
Two pathways

PNE or test stimulation

- Relatively inexpensive
- Can place multiple wires
- Learning curve
- Fluoroscopy in office helpful
- Differences in test vs final implanted electrode location/sensation

Staged stimulation/implant

- Expensive
- Operating room needed for both procedures
- Multiple electrodes more difficult/more expensive
Office test stimulation

- Kit with betadine, insulated foramen needle, wire
- Fluoroscopy very helpful
- Consider lidocaine-prilocaine cream
- 1% lidocaine local anesthesia
- 30-45 min
- Usually place 2 wires- bilateral S3 occasionally S3 and S4
Test Stimulation- Innovation
Under fluoroscopy

- Generally performed at S3 level
- Confirm wire placement under fluoro
- Sensory and motor signs for S3
  - feel stimulation in pelvis (vagina, rectum, perineum)
  - levator contraction (bellows)
  - great toe flexion
- 1-2 week test evaluation period
  - voiding diary
  - patient perception
Bilateral S3
Bilateral S3
S3 and S4
Conclusions

• SNS has evolved
• Less invasive procedure
• Two major pathways
  – Test stimulation followed by lead and IPG
  – Staged Implant