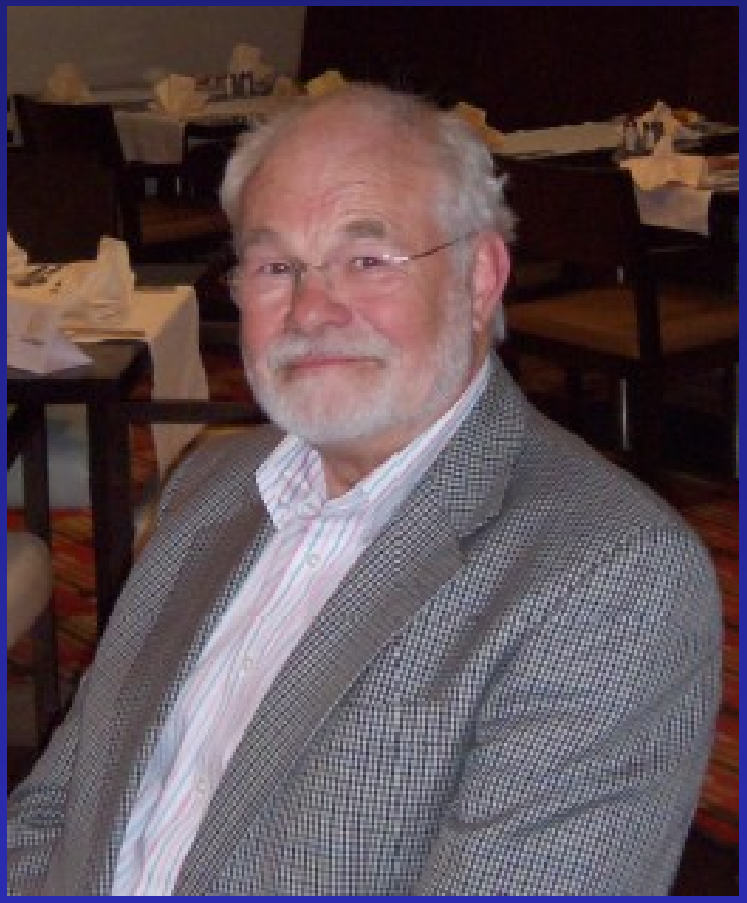
EVOLUTION OF THE SURGICAL APPROACH IN COCHLEAR IMPLANTATION.

DAVID PROOPS

BIRMINGHAM U.K.



Prof.

David Proops

Birmingham, England

- 20 years experience of cochlear implantation
- Implantet more than a thousand patients

Brief History of Cochlear Implants

- Djourno and Eyries (1957) Paris
  - Provided the first description of effects of directly stimulating the auditory nerve in deafness.
- Doyle *et al* (1964) House (1976) Los Angeles
  - Described approaching the auditory nerve through scala tympani electrode implantation. Two patients (1961). Reports of a sensation of 'hearng').
- Simmons (1966) Stanford
  - Placed a six-electrode array through the promontory and vestibule directly into the modiolar segment of the auditory nerve. Patient discerned length of signal duration and some degree of tonality.

Brief History of Cochlear Implants

- House *et al* (1970's) Los Angeles: First Generation
  - Development of a single-electrode system. House 3M was first to be commercially marketed (from 1972). In 1980 age criteria for use lowered from 18 to 2 years. Very little speech understanding by sound alone.

- 1980's Multiple-channel devices introduced: Second Generation
  - Clark (Melbourne) NUCLEUS
  - Michelson/Merzenich (San Francisco) CLARION
  - Eddington (Salt Lake City) INERAID
  - Burian *et al* (Vienna) MED-EL
  - Enhanced speech perception capabilities reported in large scale clinical trials (Gantz *et al* 1988, Cohen *et al* 1993)

- Late 1980's: Third Generation
  - Electrode and speech processor designs evolve to produce encoding strategies associated with successively higher performance levels.

Candidacy:- medical fitness.

- From the very young to the very aged.
- Co-existing pathologies.
- Fitness for anaesthesia.

Candidacy

- Age at implantation is decreasing
- Children implanted before 2 years of age show greater benefit than older children (neural plasticity, critical periods)
  - Waltzman SB and Cohen NL (1998)
  - Osberger *et al* (2002)
  - Kirk *et al* (2002)

Candidacy

- More children with good auditory skills before implantation and more residual hearing are undergoing implantation
  - Children who have useful speech perception before implantation and higher age equivalent scores on language measures would be expected to do well with a cochlear implant (Dowell *et al* 2002)

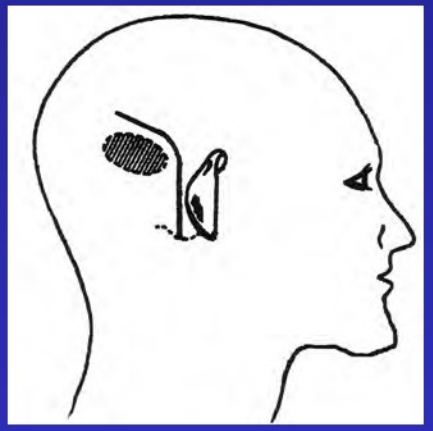
Pre-implant Evaluation

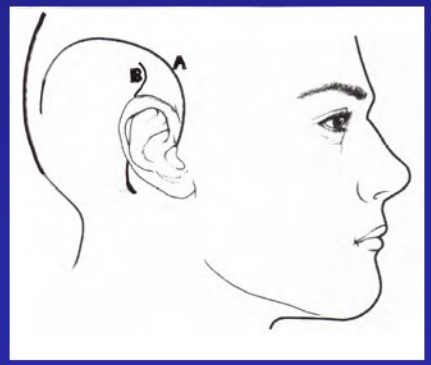
- Otologic and Medical
- Cochlear Imaging: CT, MRI
- Audiologic (air and bone conduction, immittance testing)
- Electrophysiology: EABR (electrically evoked auditory brainstem responses), SSEP (steady state evoked potential)
- Hearing aid (appropriate and optimally fitted)
- Speech and Language (perception, expression)
- Psychological

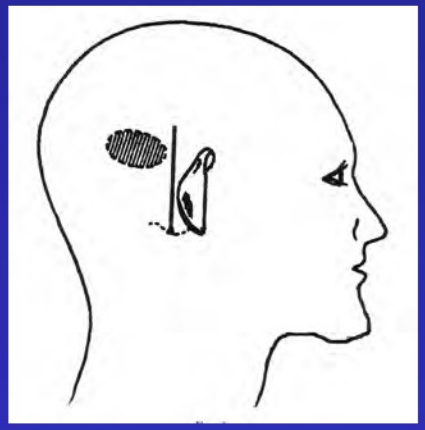
Aim of Cochlear implant surgery.

- To place electrode array in the cochlear.
- To place receiver package in the correct place on the skull.
- To cause no other damage e.g. Facial nerve.
- To preserve residual hearing.
- To avoid infection.

Incisions large and small







Surgical Issues

- Large ~vs~ Small incisions

  Wound and flap problems reduced with small incisions

- Explantation and Reimplantation

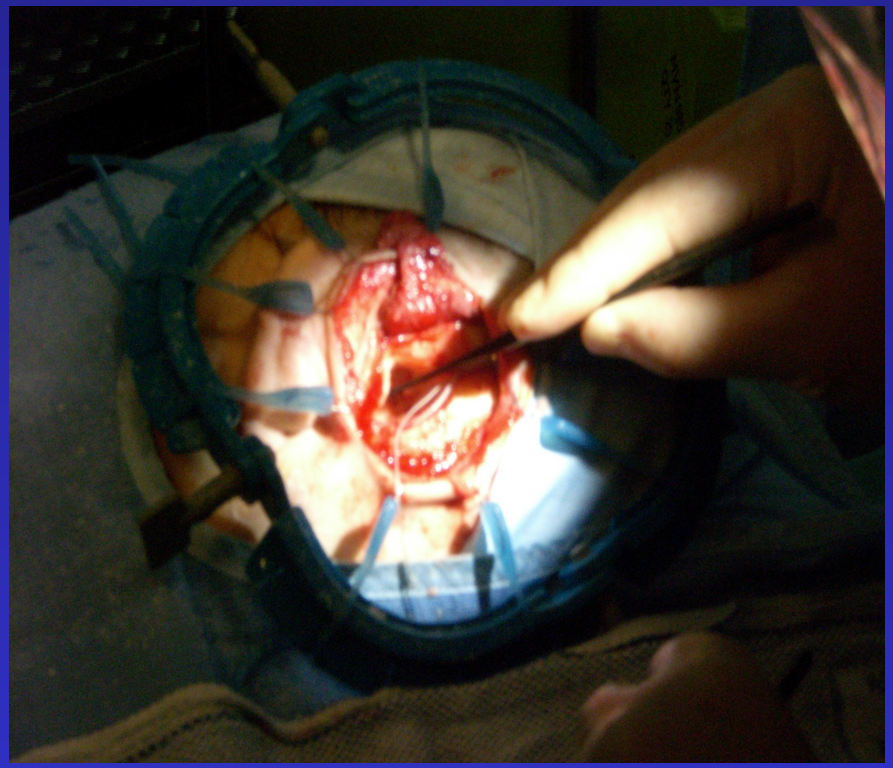
  Device failure / upgrade, wound / flap problems

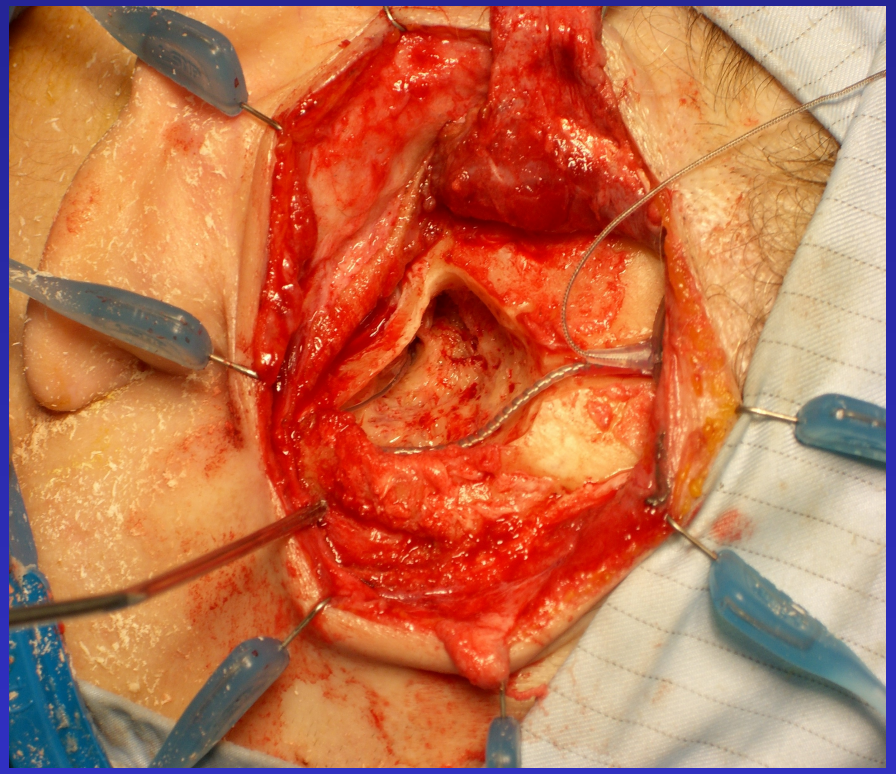
  Performance of replacement device not compromised

Approach through the bone.

- Transmastoid.
- Suprameatal.
- Transcanal.

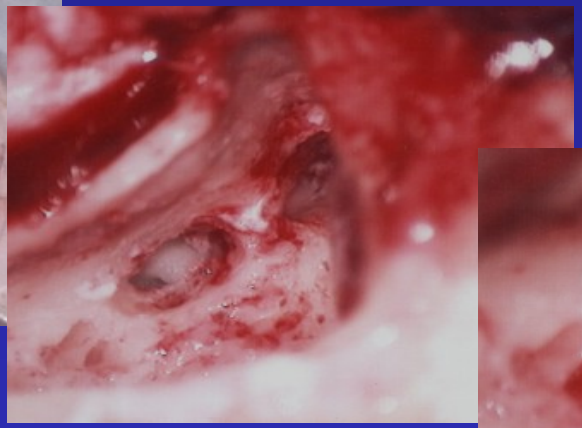
Surgical approach.





Surgery

Mastoidectomy

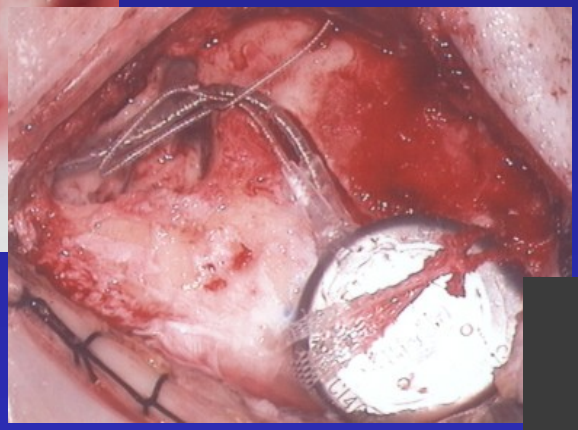


Tympanotomy

Cochleostomy

Surgery

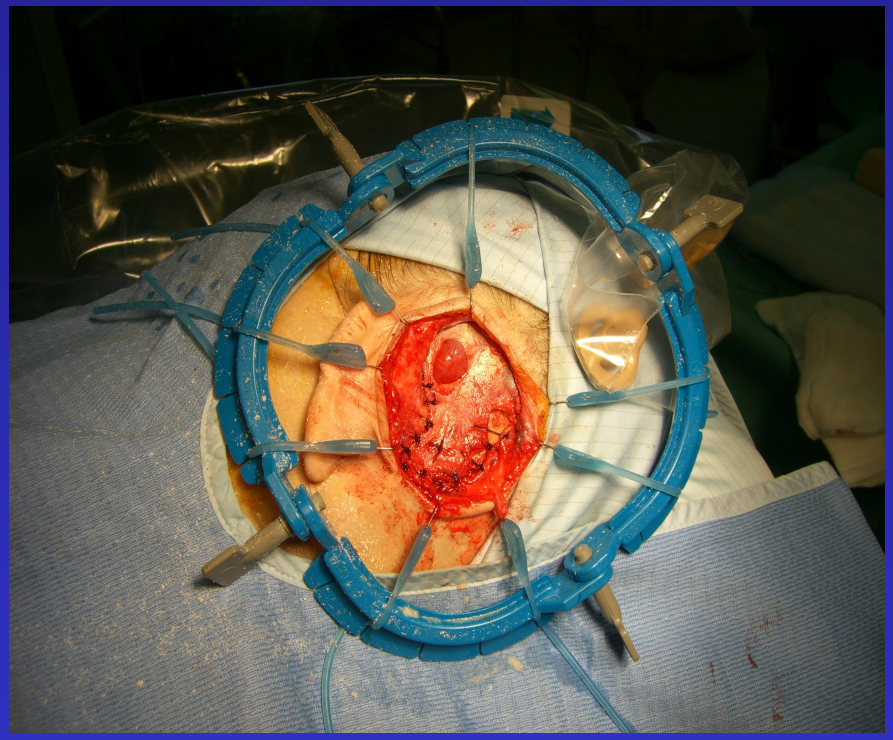
Insertion



Anchorage

Testing

Surgical closure.



CI in discharging mastoids

FAT GRAFT OBLITERATION

Abundant supply !
Easily accessible
Fibrosis rather than necrosis
Moulds itself to the contour
Easy to elevate en block

Stage I

- Mastoidectomy (radical / revision)
- Blind pit closure of EAC
- Obliteration of ET opening
- Silicone strip on promontory
- Obliteration of mastoid bowl with abdominal fat
- Closure

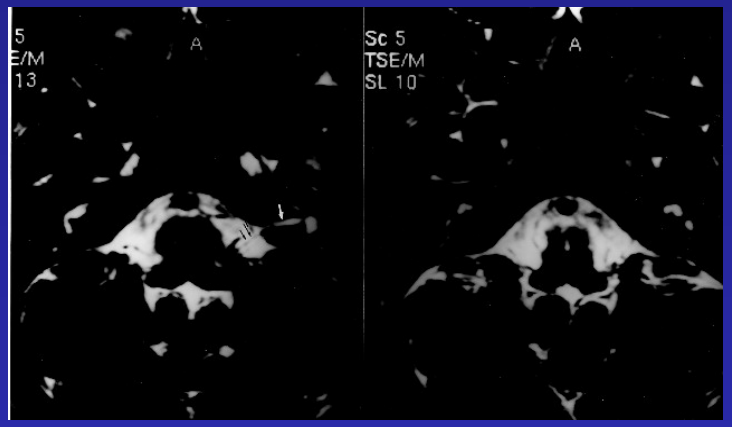
Stage II

- Mastoid dissection
- Inspection for chole / Inf.
- Preparation of implant bed
- Cochleostomy
- Implantation

Stage III

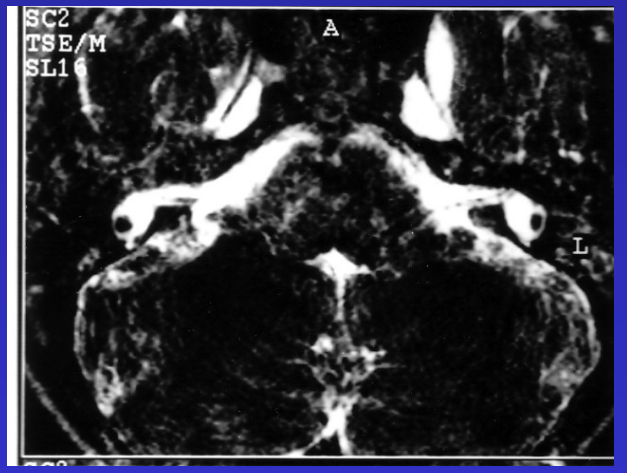
- If chole / inf in Stage II

Congenital malformations



Aplasia of cochleovestibular nerve

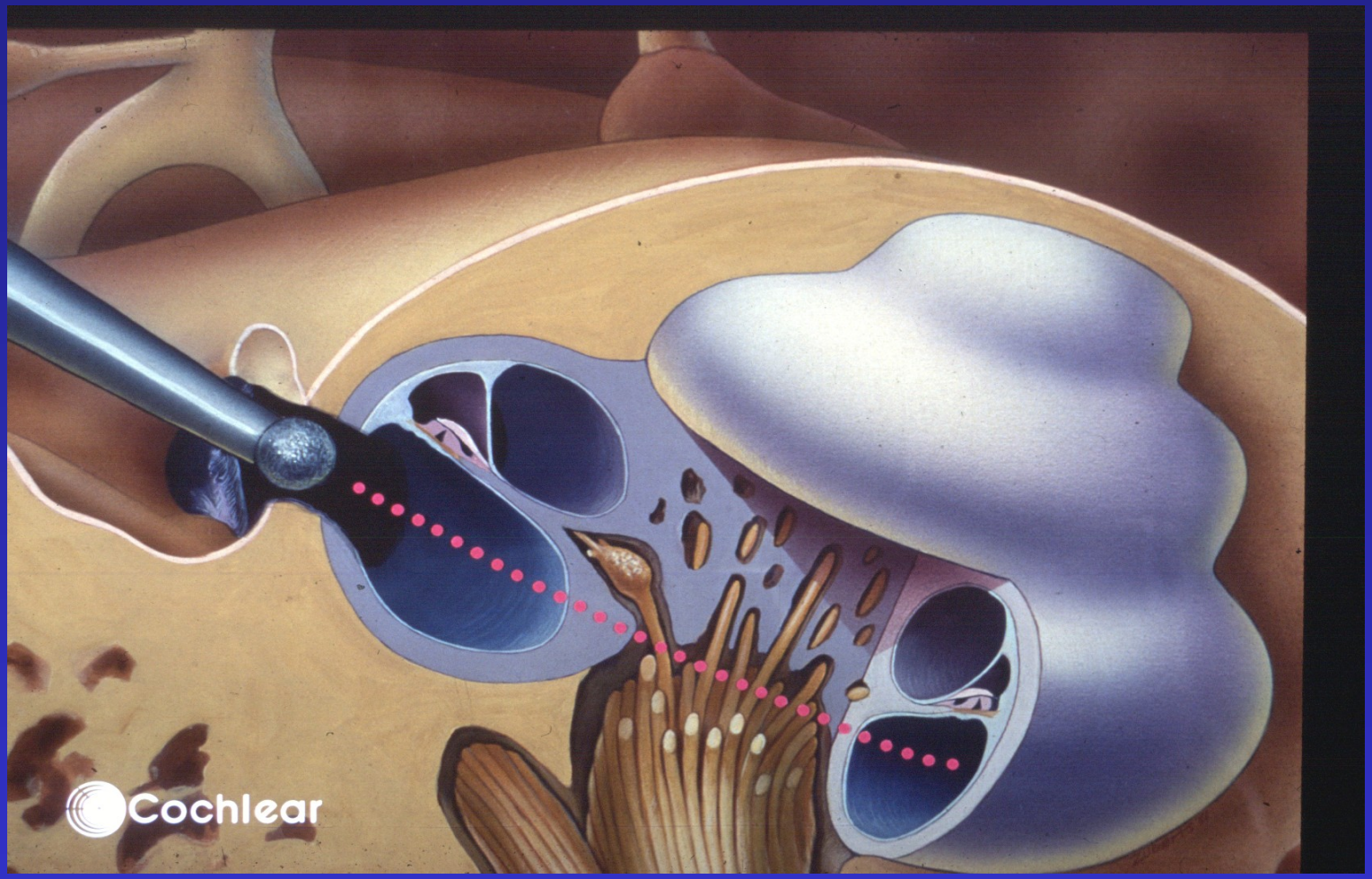
Cochleosaccular dysplasia



Current trend

- Binaural implants
- Residual hearing preservation
- Hybrid acoustic / electric stimulation
- Totally implantable devices

Cochleostomy.



“Soft” Surgery.

- Round window approach.
- Traditional Cochleostomy.
- Endosteal membrane intact.
- “Helon”
- Atraumatic insertion of electrode array.

Surgical and Medical Complications

- Scalp Flap
- Gushers.
- Otitis Media and Meningitis
  - (Cochlear Corporation report meningitis incidence of 0.12% : 4051 children to March 1998)
- Facial Nerve Paralysis
- Tinnitus and Vertigo
- Device Migration
- Device Failure

Published Complication Data

- Cohen and Hoffman (1991) 309 children, 25 surgeons in N. America
  - Total complication rate of 7%
- Miyamoto et al (1996) 100 children
  - Transient facial paresis (one case)
  - CSF gusher (one case)
- Luetje and Jackson (1997) 55 children
  - No surgical complications
  - 5 cases of device failure (9%)

The Future of Cochlear Implants

- Fully implantable device
- Binaural implants the rule
- Children under 1 year of age
- Robots.