Visionary Design

- Design Philosophy
  - Minimize insertion forces
  - In harmony with the body

- 2000: Contour™
- 2002: Contour Advance™
  with Advance Off-Stylet™ technique
Electrode Design Goals

- **Minimum trauma**
  - Small
  - Minimum forces

- **More targeted stimulation & Reduced stimulation current**
  - Close to the target nerve

- **Scientific Evaluation**

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Palo Alto: Roberson, Roberson, Roberson
Dallas: P Roland
Miami: Balkany
Freiburg: Aschendorff, Klenzner, Laszig
Competitive Trials

**MED-EL**
- Failed attempt to develop curved electrode (late ‘90)
- Significant inner ear trauma
- Deep Insertion
  - Trauma!
  - Loss of residual hearing
  - No evidence of any benefit
  - Performance decrement

**ABC**
- Pre-curved Electrode Positioner !!!!
  - No clinical effect
  - Big Cochleostomy
  - Hi risk of infection
- Outer Wall Electrode
  - Trauma!
  - Loss of residual hearing

**Neurelec**
- Outer Wall Electrode
  - Various length
  - Trauma!

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**Contour Advance™ Electrode**

77 Stimulation Channels
- To better match your recipient’s unique stimulation requirements

Softip™
- Facilitates smooth movement through the scala resulting in a gentle insertion

Free-fitting tapered design
- Ensures the electrode leaves generous space in the scala, considered important for preserving any residual hearing

Thin, self-curling array
- Places the electrodes closer to the hearing nerve fibers with minimal pressure on the delicate cochlear structures
Reasons to Believe

1. Scala Tympani
   Is it Good?
Scala Tympani is **Good**

- Scala Vestibuli
- Scala Media
- Scala Tympani
- Modiolar Wall
- Lateral Wall
- Spiral Ganglion nerve cells
- To auditory nerve
- Reissner's Membrane
- Basilar Membrane
- Hair Cells

Scala Tympani is **Good**

- Scala Vestibuli
- Scala Media
- Scala Tympani
- Modiolar Wall
- Lateral Wall
Scala Tympani is Good

Scala Vestibuli

Scala Media

Scala Tympani

Electrode

Lateral Wall

Modiolar Wall
Scala Tympani is Good

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Scala Vestibuli

Scala Media

Modiolar Wall

Electrode

Lateral Wall

Scala Tympani

Modiolar Wall

Electrode

Lateral Wall
Scala Tympani is **Good**

**THEORY**

- **Spiral Ganglion** nerves are closest to the Scala Tympani

- For accurate stimulation of the nerves, place electrode in the **Scala Tympani**, close to the modiolar wall

**BUT....**

We live in evidence based medicine !!!!
Scala Tympani is Good

Aschendorff et al (2007)

- Study to evaluate the quality of insertion including electrode position of Contour™ and Contour Advance™ electrodes in adult recipients.

- “insertions into the Scala Tympani being significantly superior to the Scala Vestibuli”


- Study to describe a new technique to determine position of electrode arrays with application to Advanced Bionics electrodes. To use this technique to measure correlation between electrode position and speech perception performance.

- “the more electrodes in the Scala Vestibuli the lower the score”
Right Insertion Depth is **Good Theory**

- **Spiral Ganglion** cells extend only 1.75 turns into the cochlea.
- 12mm = middle of the 2nd turn
- Organ of Corti extends 2.5 to 2.75 turns.

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Right Insertion Depth is **Good Theory**

- Insertion depths beyond 540 degrees have no benefit.
- Very Limited pitch range at these depths in the cochlea.
- Consequently, the goal of cochlea implants is to get the **maximum** number of separate sites along the 540 degrees of the cochlea that overlies the spiral ganglion.
Right Insertion Depth is **Good Theory**

The Contour Electrode is designed to:
- Be inserted up to 540 degrees
- Place 22 electrodes in close proximity to the modiolus
- Place no pressure on the delicate cochlear structures

- **The lateral angle** of the Scala Tympani becomes more narrow with increasing insertion depth.

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Stephen J. Rebscher et al. Considerations for design of future cochlear implant electrode arrays: Electrode array stiffness, size, and depth of insertion; *JRRD Volume 45, Number 5, Pages 731–748* 2008
Right Insertion Depth is **Good**

**New Clinical Evidence**

- **Finley et al (2008)**
  - Studied 14 “Helix” and “1j”, Advanced Bionics users.
  - Insertion beyond $\sim 420^\circ$ increases risk of loss of apical pitch discrimination
  - “..significant portion of variability in word recognition scores .. is explained by variability in scalar location and insertion depth..”

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Right Insertion Depth is **Good**

**New Clinical Evidence**

- **Gani (2007)**

  - Studied 5 Med-El users between $\sim 650^\circ$ and $720^\circ$ insertion depth.

  - "Improvements were obtained in all 5 patients (significant in 2 out of 5 patients) ... with those electrodes inserted deeper than $560^\circ$ being **deactivated**."


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Why would the electrode not be in the Scala Tympani?

1. Scala Tympani is Good

2. Lateral Wall force. Is it Bad?
Lateral Wall forces are **Bad**

- Scala Vestibuli
- Scala Media
- Scala Tympani
- Modiolar Wall
- Lateral Wall

**Straight Electrode Dislocation**

Hear now. And always.
Lateral Wall forces are **Bad**

**THEORY**
- **Lateral wall forces** during electrode insertion are likely to cause ‘dislocation’ from Scala Tympani to Scala Vestibuli
  - Away from Spiral Ganglion, **lowers performance**
  - Damages cochlea structures, **loss of residual hearing**
Lateral Wall forces are Bad

**Skinner et al (2007)**
- 100% HiFocus® electrodes dislocated into the Scala Vestibuli
- N = 9

**Aschendorff et al (2007)**
- 75% of lateral wall Contour Advance insertions resulted in dislocation into the Scala Vestibuli
- By changing to AOS technique with Contour Advance, dislocation reduced from 75% to 16%
- More on this coming up!

Excess lateral wall forces during insertion can cause the electrode to move from Scala Tympani to Scala Vestibuli
What **design & surgical technique** ensures the electrode is consistently placed in the Scala Tympani?

1. **Scala Tympani is Good**
   - ✔
2. **Lateral Wall forces are Bad**
   - ✗
3. **CA+AOS Is it Right?**
CA+AOS
Is it Right?

Is it the Right electrode?

Right electrode
Designed for atraumatic scala tympani insertion

- **Pre-curved** to match shape of the cochlea and sit close to the modiolar wall

- **AOS Technique** enables the electrode to gently **steer itself** into the cochlea

  ➔ **Avoiding lateral wall forces!!**
Right electrode

Video: Standard insertion technique

Video: AOS insertion technique
Right electrode
Correct cochleostomy location is essential

- If the cochleostomy is drilled in the incorrect location, the electrode may be inserted directly into the Scala Vestibuli

- **Cochleostomy → Start** in the Scala Tympani
- **AOS → Stay** in the Scala Tympani

Ashendorff et al (2007)
- Reported that after modifying cochleostomy location **SV insertions reduced from 62% to 14%**
CA+AOS is Right

Right electrode

Designed for atraumatic, Scala Tympani insertion
Right placement
Minimal insertion force with AOS

Roland (2005)
- Study to evaluate the **insertion characteristics** of the Contour Advance™ electrode in temporal bones.

![Insertion force graph](image)
Right placement
Roland (2005) Insertion force experiments

Insertion Force (Newtons)

0.15
0.13
0.11
0.09
0.07
0.05
0.03
0.01
-0.01
0 1 2 3 4 5 6 7 8

Insertion Depth (mm)

A
B
C
D

Standard Insertion Technique

Advance Off-Stylet

A
B
C
D

Insertion Force

Courtesy of Dr. J Thomas Roland Jr., New York University School of Medicine
Right placement
Minimal insertion force with AOS

Roland (2005)
- Study to evaluate the **insertion characteristics** of the Contour Advance™ electrode in temporal bones.

- “The Contour Advance electrode, inserted with the AOS technique, represents a **significant improvement** over the Contour electrode, inserted with standard insertion technique”

Aschendorff et al (2007)
- By changing to AOS technique with Contour Advance, dislocation reduced from **75% to 16%**
CA+AOS is Right

- Right electrode
- Right placement

Minimal insertion force on lateral wall
Right Result
Better performance & hearing preservation

Aschendorff et al (2007)
• 20% improvement in sentence understanding

Fraysse et al (2005)
• Hearing was preserved in 75% of recipients implanted with Contour Advance using AOS and soft surgery techniques

Greater use of Contour Advance with AOS further enhances Freedom as the hearing performance leader

1. Scala Tympani is Good
2. Lateral Wall forces are Bad
3. CA+AOS is Right Electrode Placement Result
Summary

- **Scala Tympani is good**
  - New evidence shows Scala Tympani electrode insertion results in significantly better hearing performance

- **Lateral wall forces are bad**
  - Excess lateral wall forces during insertion can cause the electrode to move from Scala Tympani to Scala Vestibuli

- **Contour Advance™ with AOS is right**
  - **Right Electrode**: Designed for atraumatic, Scala Tympani insertion
  - **Right Placement**: Minimal insertion force with AOS
  - **Right Result**: Better performance & hearing preservation

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**Summary**

- **Scala Tympani is Good**
  - *Aschendorff et al. (2007)*
    - "insertions into the Scala Tympani being significantly superior to the Scala Vestibuli"
  - *Skinner et al. (2007)*
    - "the more electrodes in the Scala Vestibuli, the lower the score"

- **Lateral Wall forces are Bad**
  - *Skinner et al. (2007)*
    - 100% of HiFocus® electrodes dislocated into the Scala Vestibuli
  - *Aschendorff et al. (2007)*
    - By changing to AOS technique with Contour Advance, dislocation reduced from 75% to 16%

- **Contour Advance™ + AOS is Right**
  - **Right electrode**
    - Designed for atraumatic, Scala Tympani insertion
  - **Right placement**
    - Achieves design goals: *Aschendorff et al. (2007)*
      - Roland (2005)
  - **Right result**
    - Performance: *Aschendorff et al. (2007)*
    - Preservation: *Frayssé et al. (2005)*
Thank you!