

*CT-scan contouring technique (CoT):
implication in cochlear implantation with
straight electrode-arrays*

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Outline

- Overview
- Aims and purposes
- Methodology (Image analysis)
- Results and Conclusion

Overview – why do it

- More than 45,000 CIs are sold worldwide each year
- The global CI market is likely to exceed USD 2 billion by the year 2020
- In modern cochlear implantation surgery, an important goal is preserving residual hearing and auditory structures
- There are large inter-individual variations in cochlear anatomy that determines the insertion depth.

Why do it?

- The rate of cochlear trauma appears to increase with insertion depth, the EA should preserve the residual hearing coding the regions of low frequency.
- Cross-sectional imaging plays an essential role in cochlea pre-implantation, to avoid cochlear trauma during operation.

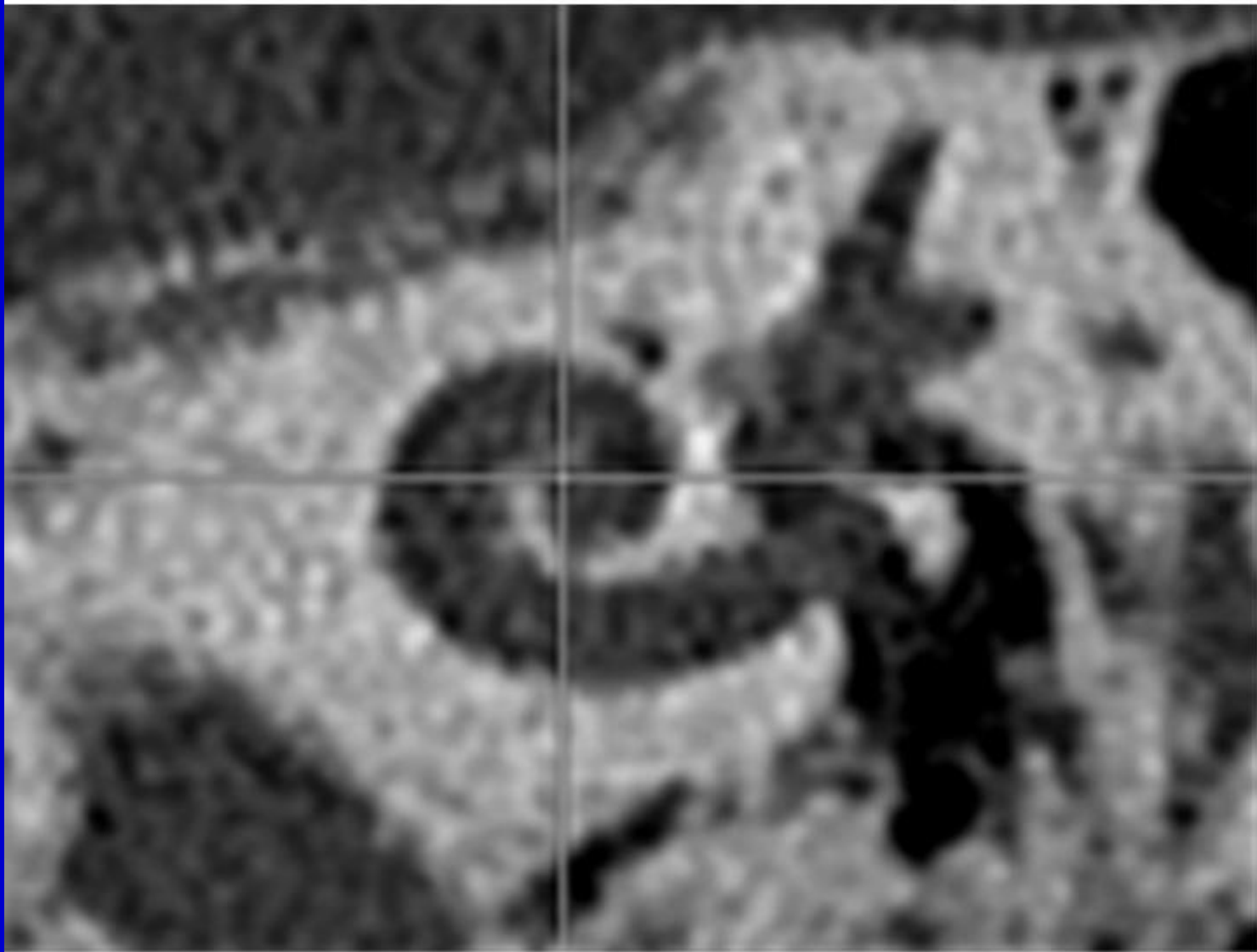
How we do it

- Patients do temporal bone CT scans without ear malformation, neither anormal cochlear nor uninterpretable examinations.
- GE 750 HD 64 slices, 0,625mm slice thickness.
- The CT measurements were made on a workstation
- Two radiologists with 3 years and > 30-year experience reviewed the images

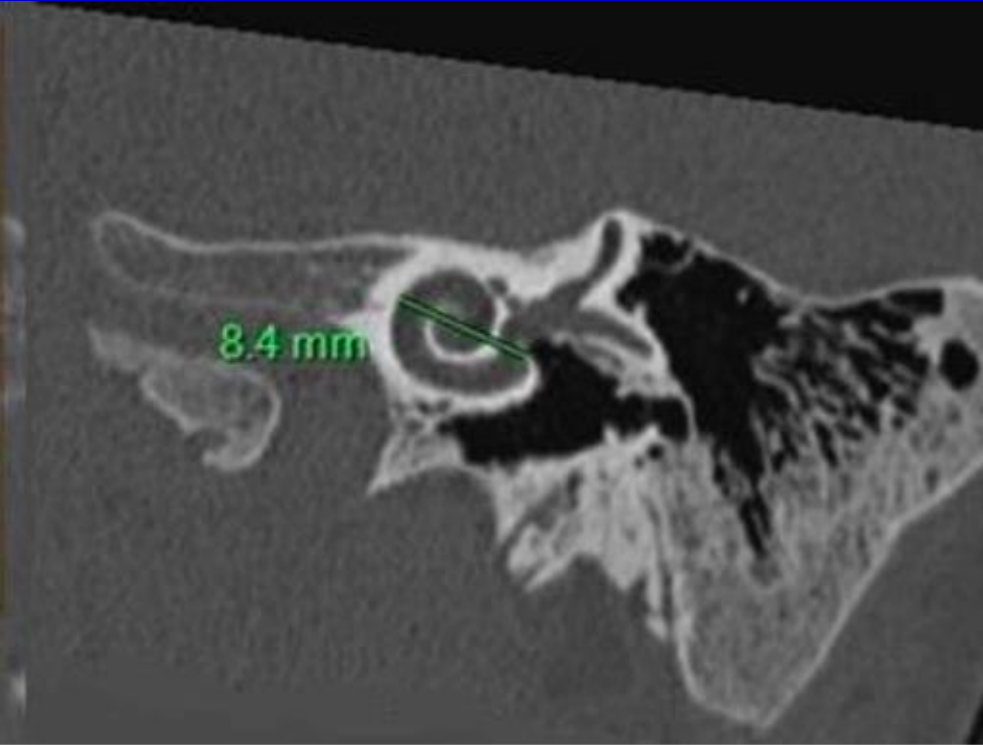
How we do it?

- The length of the cochlea is often **indirectly** estimated by the “distance A ” using Escudé’s method.
- With the current accuracy of CT-scans, we **directly** measured the cochlear size on CT-scans by contouring the external wall of the cochlea, mimicking the route of a straight EA of cochlear implant.

How to do?



Escudé's methods



$$L = 2.62A \times \log_e (1.0 + \theta/235).$$

With $\theta = 360^\circ$, the formula gives: $L_{360^\circ} = 2.434A$.

With $\theta = 540^\circ$, the formula gives: $L_{540^\circ} = 3.126A$.

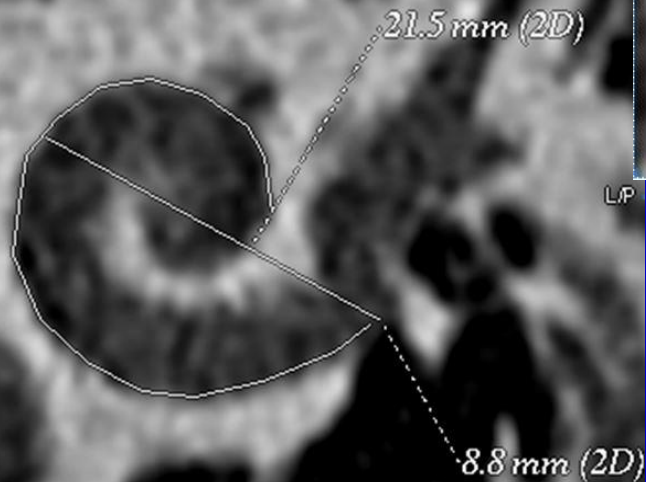
How do it

Mole, Christine
DOB: 15-Nov-1955 59
10-Mar-2015 17:09
Ac: A10052557484
Series: 350

S

Radiologie A (GM)
Discovery CT750 HD c01
512 x 512 x 16
Images traitées

R/A

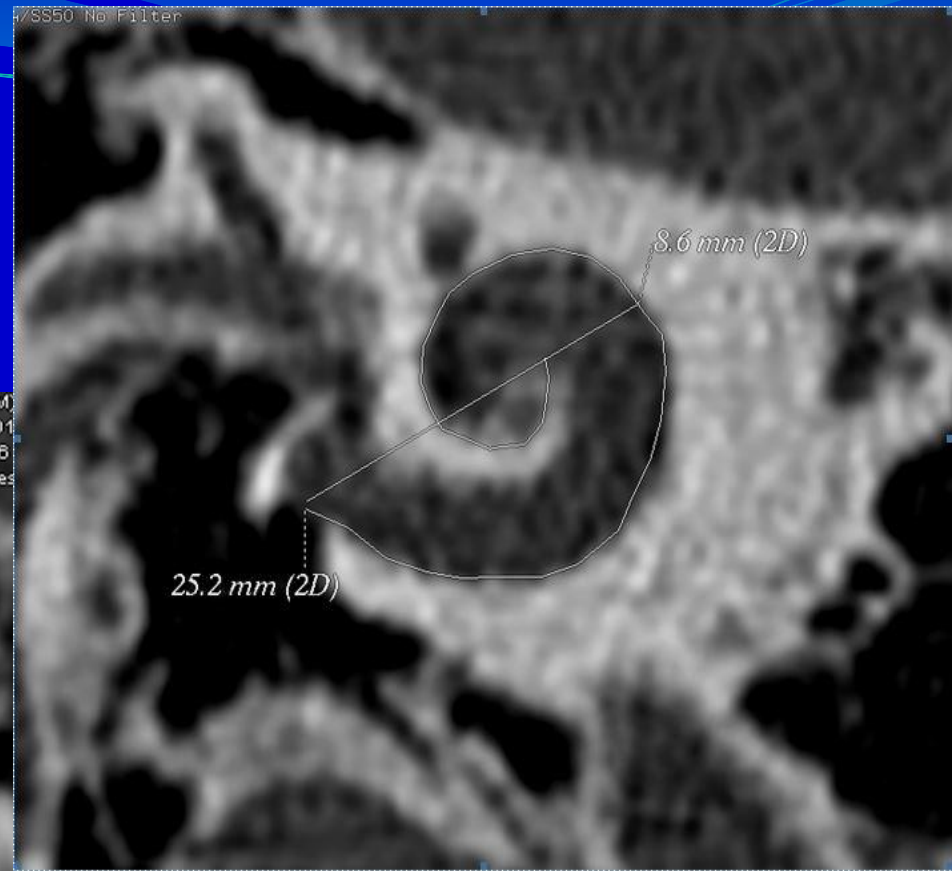


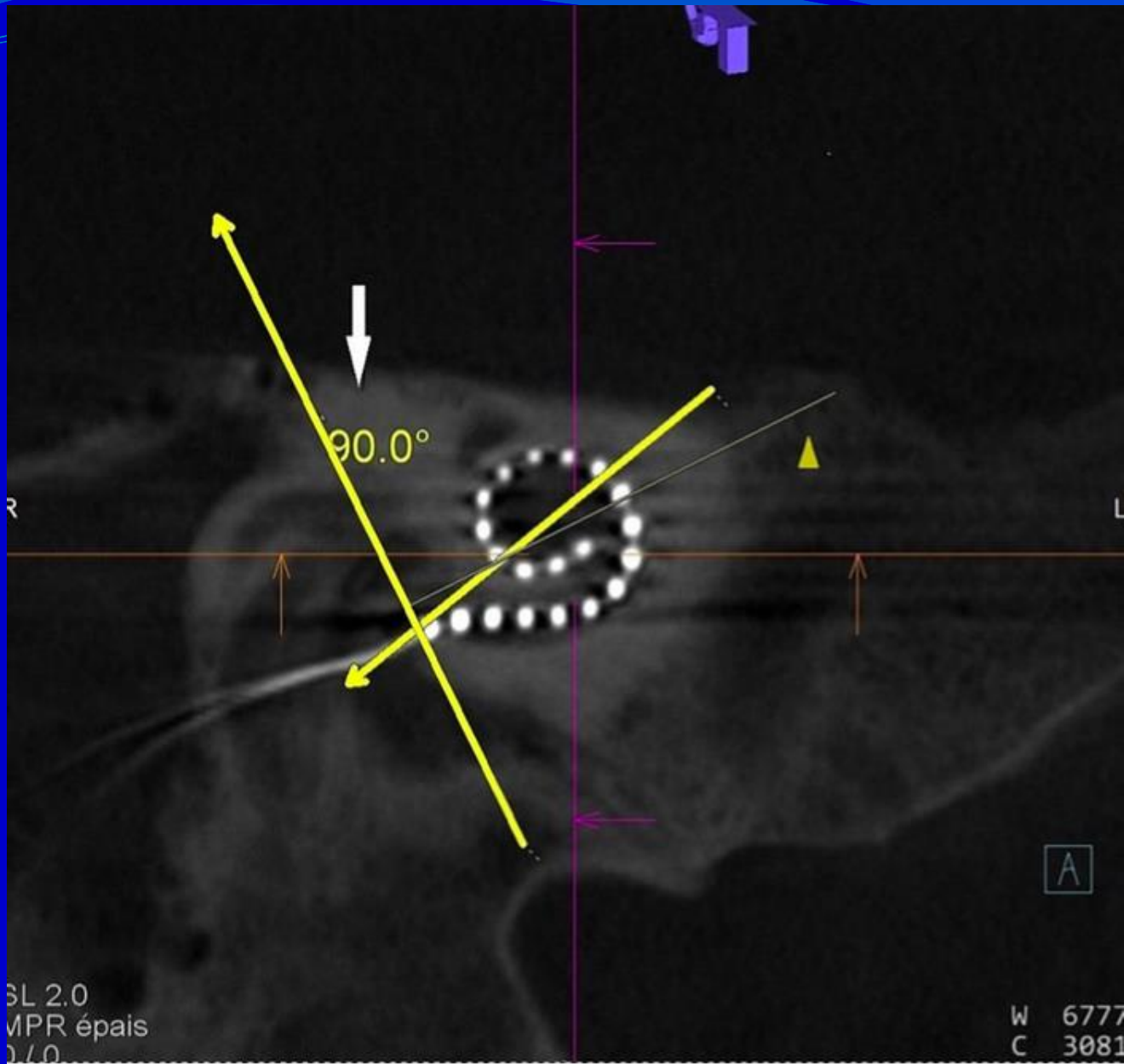
L/P

mA: 350
kV: 120.00
Slice: 0.10

W: 4000 L: 1300
Filter: None Fact: 0
Image: 1

47SS50 No Filter





Results

- 200 temporal bones were included in this retrospective study. Patients had average age 53.3 years (13–85 year old)
- First, in the 15 patients with cochlear implant, the CoT proved to give measurements **highly accurate** when compared with the real length of EA-insertion ($R= 0.9744$, $p < 0.001$).

Results

- The distance A and L_{360° and L_{540° were significantly greater in men than in women

Table 2 Mean, standard deviation and range of measurements by sex

	Female ($n = 64$)	Male ($n = 36$)
Diameter A (mm)	8.92 ± 0.38 8.2–10.4	9.16 ± 0.42 8–10
Measured L_{360° (mm)	21.5 ± 0.87 19.7–24.7	22.0 ± 1.0 18.8–24.1
Measured L_{540° (mm)	25.7 ± 1.3 23–29.6	26.2 ± 1.5 21.3–29.5

Results

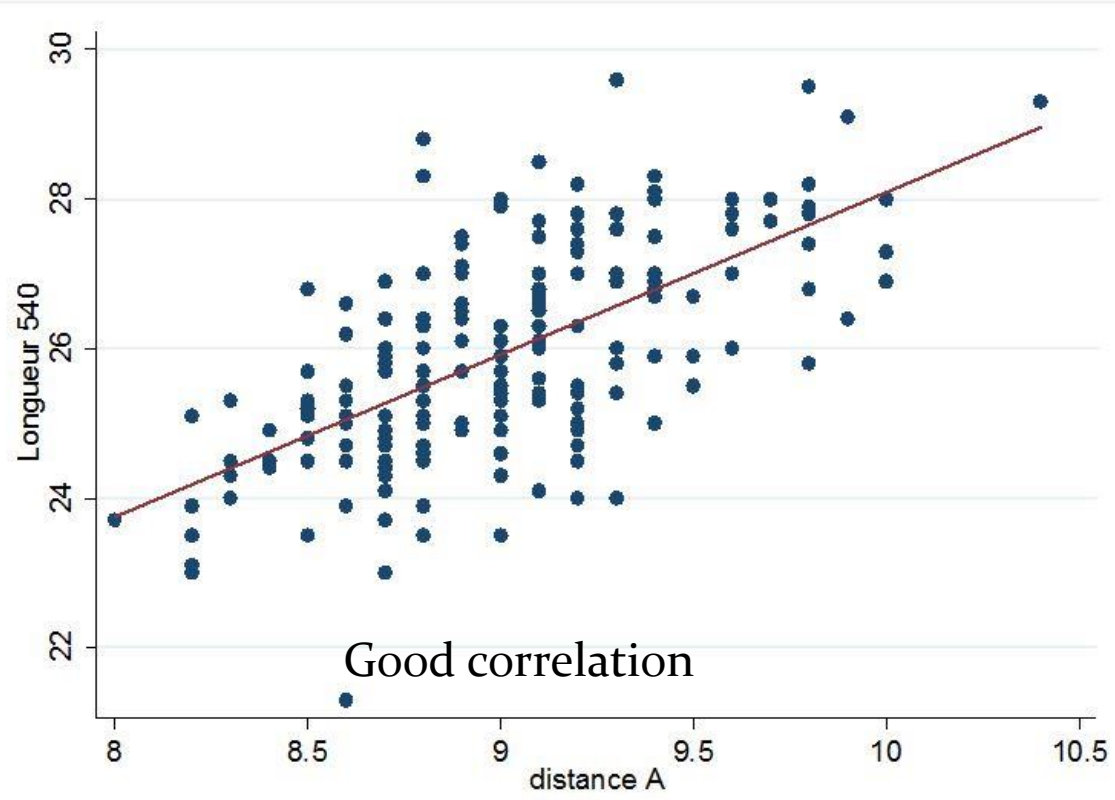
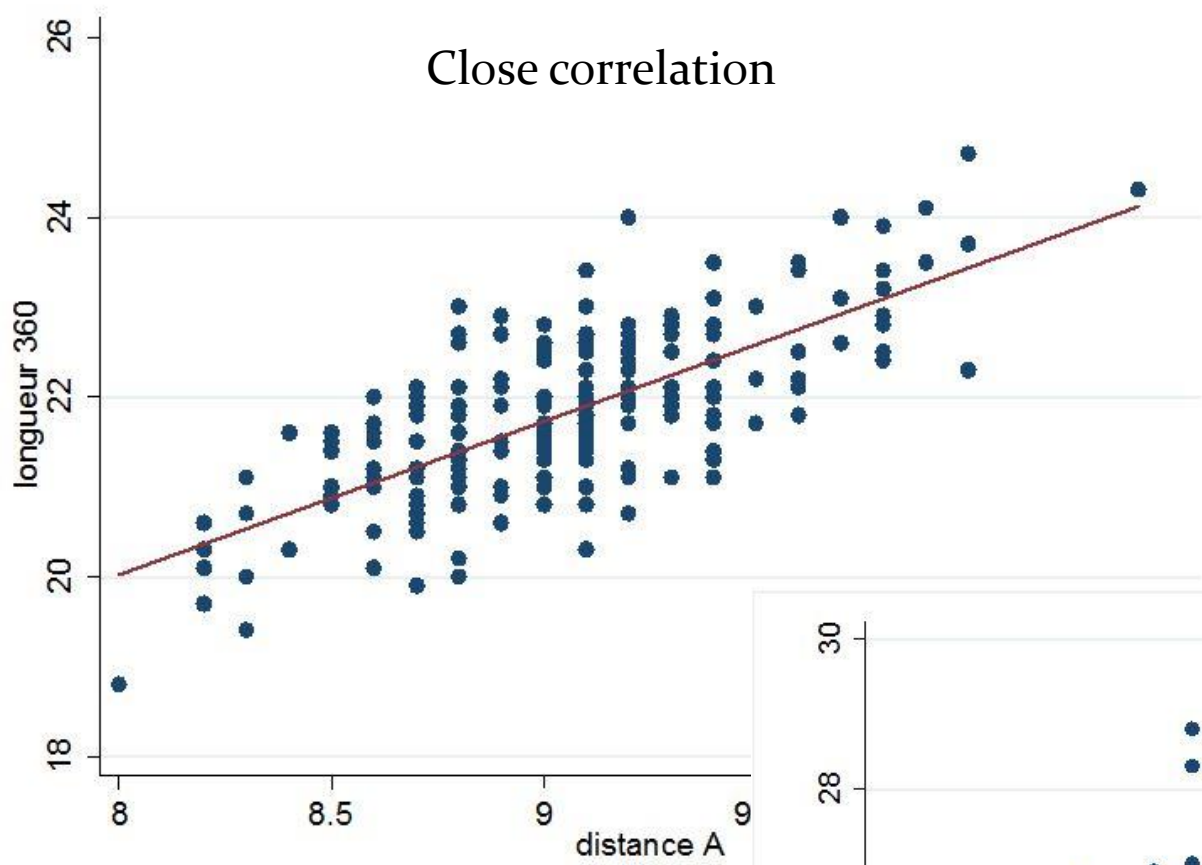
- There was no significant difference for any of the dimensions measured between the right and left sides

Table 3 Mean, standard deviation and range of measurements by side

	Right	Left
Diameter <i>A</i>	8.9 ± 0.41 8–10	9.0 ± 0.4 8.2–10.4
Measured L_{360° (mm)	21.7 ± 0.9 18.8–22.6	21.7 ± 0.9 19.4–24.3
Measured L_{540° (mm)	25.9 ± 1.4 21.3–29.6	25.9 ± 1.3 23–29.3

Results

- The intra-individual mean difference between Escudé's methods and contouring technique for $L360^\circ$ was 0.2 ± 0.7 mm and ranged from -1.6 mm to $+2.0$ mm.
- Intra-individual difference of measurements between the two methods for $L540^\circ$, was on average 2.2 ± 1.2 mm and ranged from -1.3 mm to $+5.6$ mm.



Conclusion

- The CoT can predict with accuracy the length of EA-insertion depth, more precisely than estimation methods.
- The CoT provides highly reliable measurements of cochlear length.

Conclusion

- Should DO temporal bone CT scan and measure the length of cochlear by Contouring technique before cochlear implantation.



Thank you for your attention!

CT-scan contouring technique allows for direct and reliable measurements of the cochlear duct length: implication in cochlear implantation with straight electrode-arrays

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