

# Background Reading Paper Presentation

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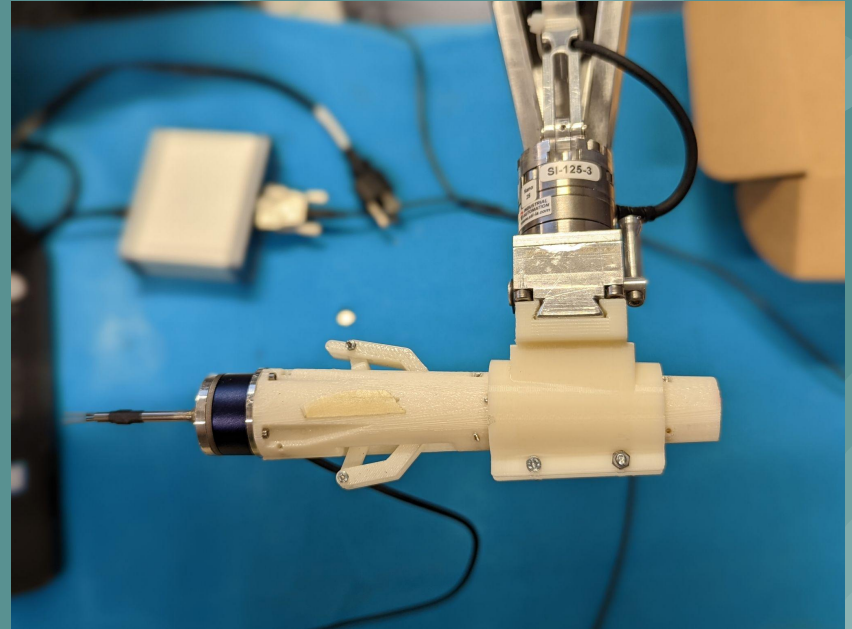
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# Force Sensing Forceps for Cochlear Implant Surgeries

## Project Background:

- Force Sensing Forceps
  - A device which is used to assist in Cochlear Implant Surgeries which determines the forces during electrode insertion.





# **Systematic review: Radiological and histological evidence of cochlear implant insertion trauma in adult patients**

Authors:

Emma Hoskison, Scott Mitchell &  
Chris Coulson

*(ISSN: 1467-0100 (Print)*

*1754-7628 (Online) Journal*

*homepage:*

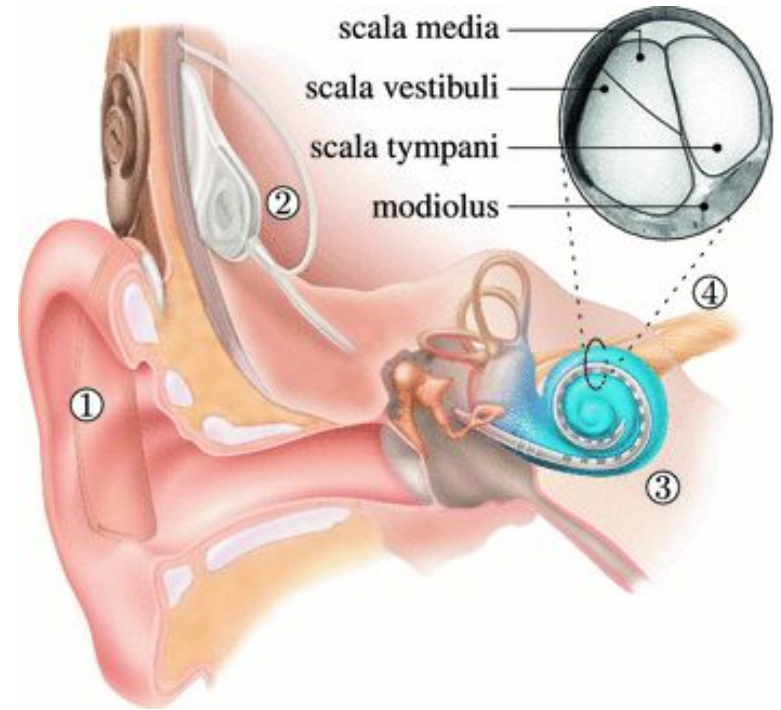
*<https://www.tandfonline.com/loi/ycii>*

*20)*



## Summary

- Researchers studies were to elucidate the degree of trauma associated with Cochlear Implantation(CI) insertion.
- This study was the base of our project determining the CI insertion trauma.



Kobler, JP, Beckmann, D., Rau, T.S. *et al.* An automated insertion tool for cochlear implants with integrated force sensing capability. *Int J CARS* 9, 481–494 (2014). <https://doi.org/10.1007/s11548-013-0936-1>



# Methodology

- A systematic search of the literature was performed using several databases including PubMed, Medline, Cochrane Database, AMED, EMBASE, and CINAHL.
- *Study Selection Criteria [\*MeSH Descriptor]*

Cochlear implants	Cochlear implants* ti.ab	Exp outcome
Exp electrode insertion trauma	outcome*.ti.ab	Exp hearing preservation

- *Outcomes:* Presence or absence of histological or radiological evidence of cochlear trauma



# Flow Chart of Search results

## -Data Extraction:

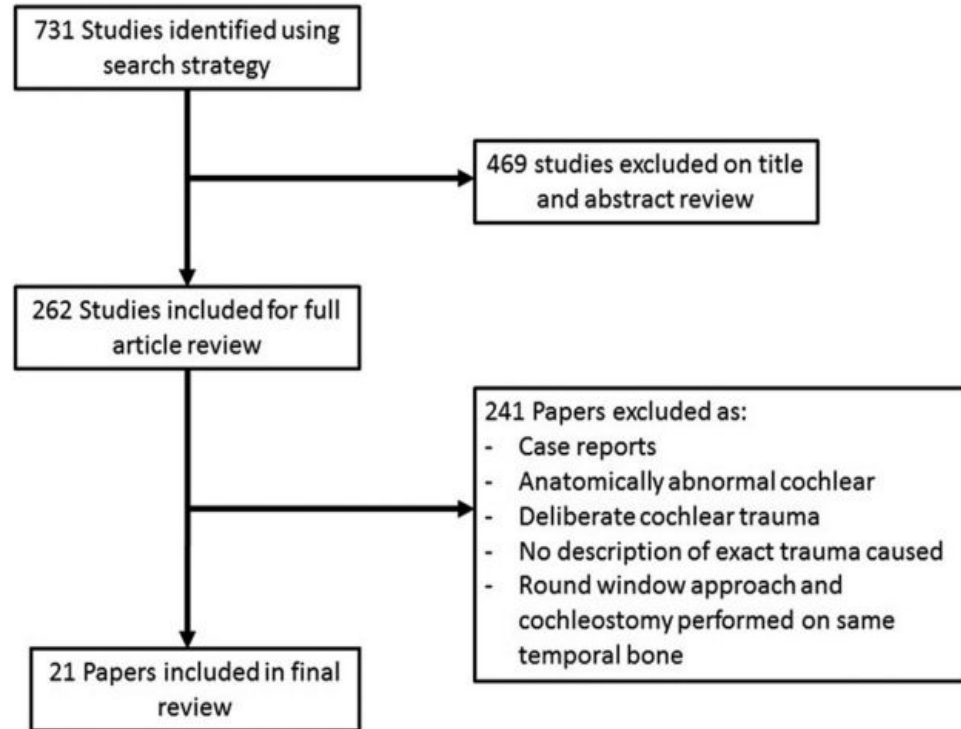
Methods of analysing cochlear trauma and grade of trauma were collected

## -Quality Assessment:

The level of evidence was noted and graded as per the Centre for Evidence Based Medicine (University of Oxford).

## -Data Synthesis:

Data heterogeneity between studies, methodology and the measurement of differing outcomes prevented pooling of results for formal meta-analysis.





# Results

Methodology	Number of studies	Number of implants	% of total implants
Histology	3	45	6.5
CT	7	231	33.7
X-ray	2	270	39.4
Histology and X-ray	3	74	10.8
Histology and CT	6	66	9.6
	21	686	100

## Methods Used to access trauma

Insertion technique	Precurved	Standard	No information	Total
Frequency	130	165	358	653
Trauma	41	30	44	115
%	31.5%	18.2%	12.3%	17.6%

## Cochlea trauma rates and surgical insertion technique used



# Results

Grade of trauma	Frequency	% of total
1 Basilar membrane elevation	13	10.5
2 Basilar membrane disruption	16	12.9
3 Trajectory ST to SV	89	71.8
4 Fracture of spiral lamina, modiolus and tearing of SV	6	4.8

- Overall a cochlear implant insertion trauma rate of 17.6% is shown in this review

Array type	Med EI	ABC	Cochlea straight array	Contour advance	Total
Frequency	88	46	69	92	295
Trauma	17	15	13	26	71
% of group	19.3 (17/88)	32.6 (15/46)	18.8 (13/69)	28.3 (26/92)	24.1(71/295)



# Force Perception Thresholds in Cochlear Implantation Surgery

Authors:

*Louis B. Kratchman, Daniel Schuster, Mary S. Dietrich, and Robert F. Labadie Vanderbilt University*

Audiol Neurotol. 2016 ; 21(4):  
244–249.

doi:10.1159/000445736.

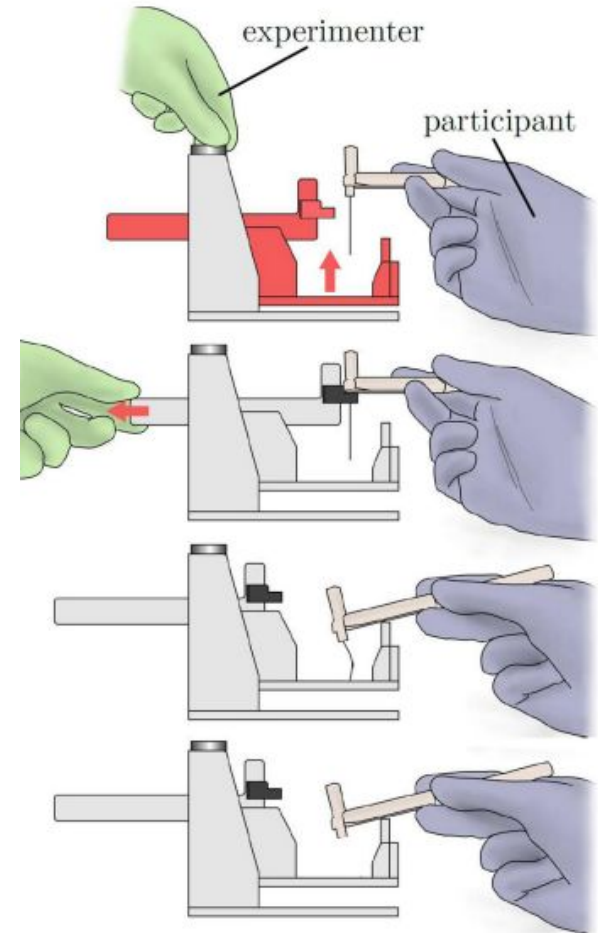


## Summary

- Researchers simulated Cochlear Implantation(CI) surgery using a benchtop apparatus to repeatedly apply small forces to surgeon's hands while reducing variability in their hand movements.
- They have used a psychophysical testing procedure to estimate the force perception thresholds of ten otologic surgeons, and found a median threshold of **20.4 mN**.

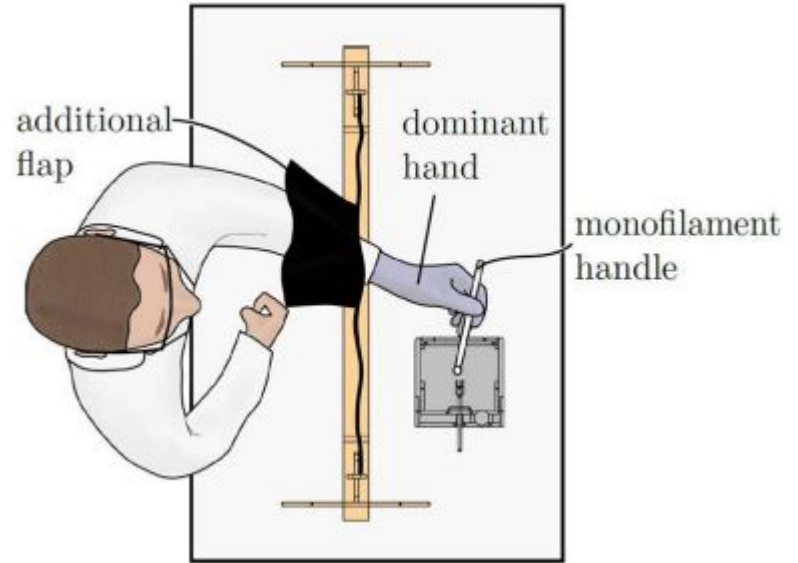
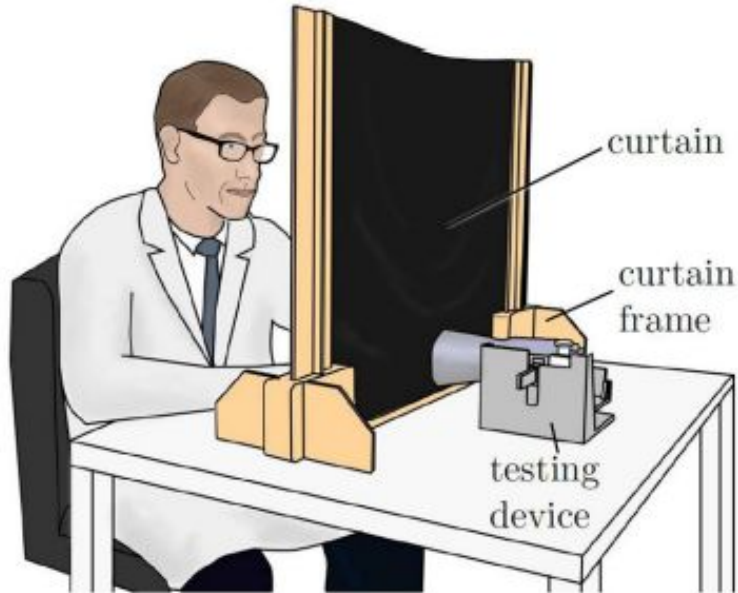
# Methodology

- Authors recruited 12 subjects who actively performed CI surgery in their clinical practice.
- Researchers used **Semmes-Weinstein Monofilaments (SWM)** to apply forces, which are handles embedded with a nylon monofilament (a single strand of filament).
- Each filament is calibrated to buckle when a force applied along the filament axis exceeds a particular intensity.



**Semmes-Weinstein Monofilament (SWM) trials**

# Experimental Setup



An opaque curtain is placed between subjects and the testing device to prevent visual observation of the experimental apparatus and experimenter during trials



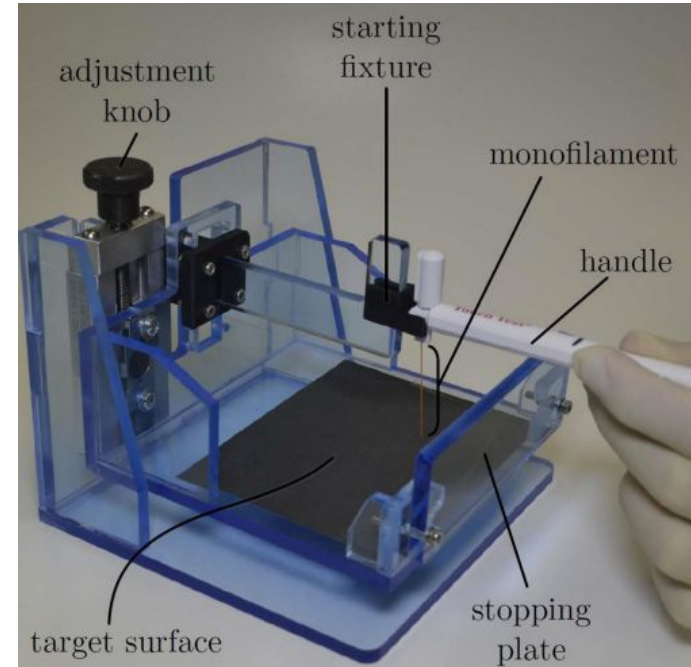
## **Procedure (2AFC, three-down, one-up (3D1U) staircase procedure)**

1. Subjects grasped SWM handles as they would hold a forceps to implant a cochlear implant electrode, with the filament in the approximate position of an electrode.
2. By buckling the filament, a calibrated force was applied to subjects' hands in a way that resembled the transmission of force through CI forceps
3. A logarithmic scale is used because the perceived intensity of sensory stimuli is approximately proportional to the logarithm of the intensities of those stimuli.



# Apparatus

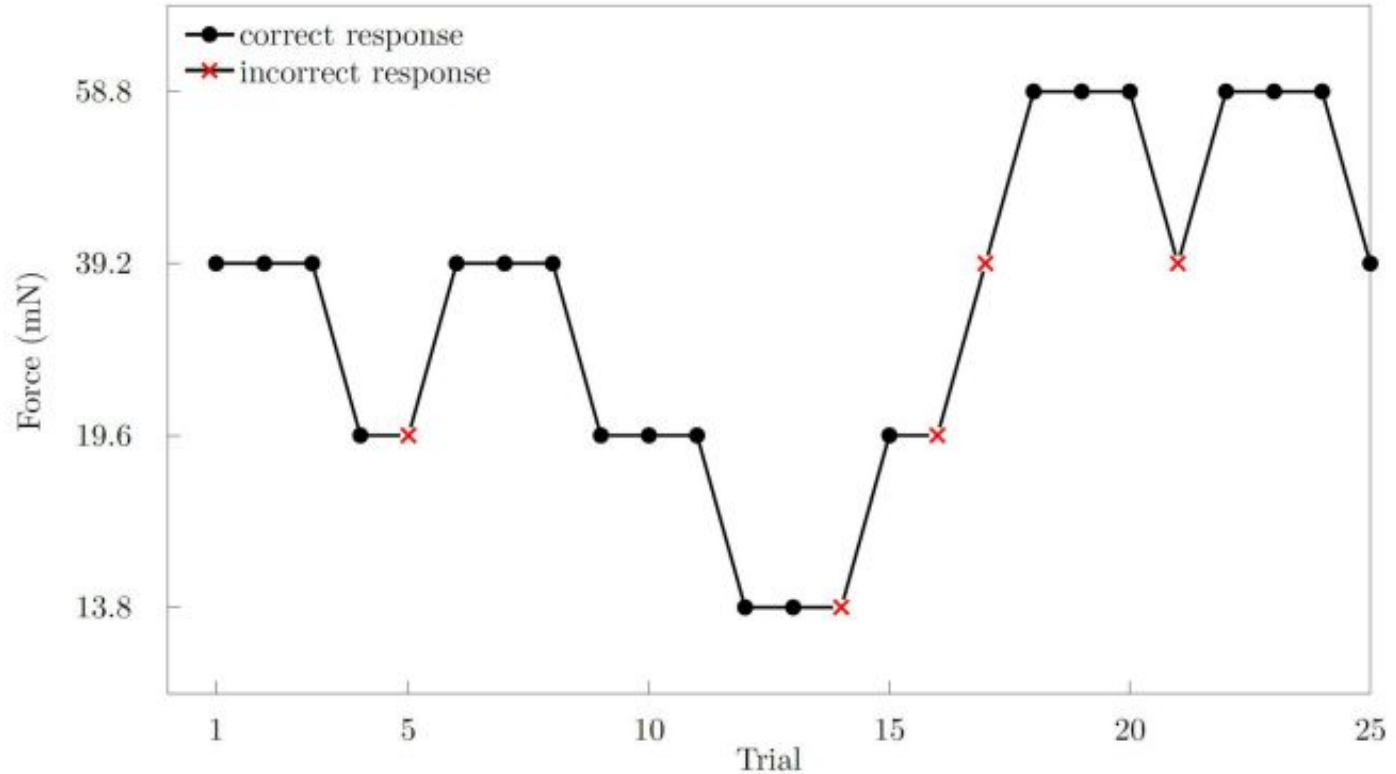
- A custom-built testing device used to model the advancement of forceps and transmission of electrode-basilar membrane contact forces during Cochlear Insertion.





# Results and Discussion

- 2AFC-3D1U  
staircase  
procedure
- Median threshold  
of **20.4 mN**, with a  
range of 10.8 mN  
to 36.5 mN.





## Conclusion

- Paper 1 provides the motive behind the percentage of the Cochlear Insertion trauma which led to the investigation of the numerical analysis of the Force measurement.
- Paper 2 derives the threshold forces which was the base of our project while electrode insertion.
- More detailed study and widespread survey can provide more accurate results.