Thin Film Array Electrode Insertions in Cadaveric Feline Temporal Bones

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ABSTRACT

Background: Thin film array (TFA) electrodes were proposed to improve functional ability of cochlear implants (CI). After the prototype polymeric TFA electrode coupled with insertion test device (ITD) yielded full insertion in human cadaveric temporal bones, a trial with a modified insertion electrode (IE) device backed TFA in a cadaveric feline model was performed.

Methods: Nine cadaveric cats weighing 1.76-4.3 kg were obtained. Insertions with an ITD backed TFA, IE backed TFA, short TFA, and long TFA were completed on one to three ears in the first group. In the second group, all ears underwent implantation with all electrodes.

Results: The second group of cats (#5-9) had better ease of insertion and insertion depth with all electrodes. The IE had the best mean insertion depth, followed by the two unbacked TFAs and finally the backed-TFAs. There was no consistent pattern with cat weight or side of insertion. Delamination of the TFA-backed devices were noted within a few insertions.

Conclusion: Adequate insertion depth was gained with the IE, ease of insertion improved with increasing size of cat, freshness of the cat, and surgeon experience. A backed TFA increased the width of the prototype and delamination. Unbacked TFAs were inserted with more difficulty, and were easily damaged. Further pilot insertions with additional modifications are necessary.

INTRODUCTION

• Current CI’s limited by functional ability to provide a high resolution of pitches
• Important for hearing in social situations and for music appreciation
• TFA’s proposed to improve functional ability
• TFA designed by authors of the current project yielded full insertion in human cadaveric study
• This study compares different insertion platforms for the TFA in a cadaveric feline model in preparation for live insertions

METHODS

• 9 cadaveric cats obtained
• Group 1 (1-4) thawed and frozen several times vs Group 2 (5-9) only thawed once
• Five platforms obtained for insertion
  - Compliant insertion electrode (IE)
  - IE backed TFA (IE-TFA)
  - Platinum stiffened insertion test device backed TFA (ITD-TFA)
  - Short unbacked TFA
  - Long unbacked TFA
• C-type postauricular incision
• Dissection carried down to bulla and a 5x5 mm bullotomy completed revealing round window
• Insertion performed on 1-4 cats in group 1 and all cats in group 2 with each insertion platform
• Insertion platforms (IP)
  A Polyimide thin-film array, 21 high-density Pt sites, 180/250 μm dia/spacing
  B MED-EL Insertion Test Device (ITD)
  C MED-EL Silicone Insertion Electrode (IE)

RESULTS

Table 1. Mean insertion depth for group 1 (cats 1-4) and 2 (cats 5-9). Group 1 cats were thawed and refrozen repeatedly while group 2 cats were only thawed on one occasion. Group 1 cats all underwent insertion with IE. Only 1-2 cats had insertion with other electrodes. In group 2, all cats underwent insertion with all electrodes.

Table 2. Mean insertion depth based on weight of cat. There was no consistent pattern with the cat.

Table 3. Mean insertion depth by side of insertion. There was no consistent pattern with side of the cat.

DISCUSSION AND CONCLUSION

• Insertion with all platforms was easier and yielded better insertion depth with fresher cats
• This may also reflect a learning curve given this was the second group of cats
• Using a compliant device with some mass was beneficial for ease of insertion
• IE and ITD-backed TFAs had poor depth of insertion and quickly delaminated likely secondary to narrow diameter of the feline scala vestibuli
• Full insertion was obtained with the unbacked TFAs but was technically cumbersome due to low mass
• We propose a TFA lined with a thin silicone strip for live feline surgeries

REFERENCES


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