Building healthier lives

Early Activation of Cochlear Implants: A Systematic Review and Narrative Synthesis

University Hospitals Birmingham NHS Foundation Trust

Rosalyn Parker[1], Jameel Muzaffar[2], William Brassington[1]

[1]Audiology Department, University Hospitals Birmingham NHS Foundation Trust, Birmingham, UK

[2]Department of Ear, Nose and Throat Surgery, University Hospitals Birmingham NHS Foundation Trust, Birmingham, UK

Correspondence: rosalyn.parker@uhb.nhs.uk

Background

Cochlear implant device activation typically occurs four weeks post cochlear implant surgery.

Emerging evidence suggests earlier activation is feasible and beneficial, giving patients quicker access to sound and rehabilitation.

Objectives

In this review, we aimed to observe cochlear implant (CI) outcomes following early sound processor activation.

Methods

Electronic searches of Medline/PubMed, AMED, EMBASE, CINAHL and the Cochrane Library following PRISMA guidelines.

The PICO strategy was used to identify population (**P**), Intervention (**I**), Comparison (**C**) and Outcomes (**O**) as below:

P: Children or adults receiving cochlear implantation
I: Early sound processor activation as per clinical practise
C: Conventional switch on as per routine clinical practise
O: Audiometric outcomes, patient outcomes, complications

Studies investigating any aspect of early activation were included for review.

Two reviewers screened abstracts against eligibility criteria. Disagreements were referred to a third reviewer for adjudication.

Studies were assessed for quality and bias risk using Down and Black Checklist[1].

The following outcomes being reported in the literature:

- Patient demographics
- Surgical technique
- Impedance levels
- Magnet strength,
- Complication rate
- Subjective outcomes

Materials

- Studies used populations from the following countries: *Taiwan, China, Japan, Turkey, Saudi Arabia, France, Germany, Italy and Austria.*
- Cochlear™ and MED-EL implant devices and electrode arrays were widely represented across the available literature Advanced-Bionics or Oticon Medical devices were limited.

Surgical Technique

All studies used a minimally invasive approach for implantation with mastoidectomy and posterior tympanotomy approach:

- 259 cases round window approach
- 34 cochleostomy approach
- 251 undefined cases

For successful early activation a minimally invasive surgical technique needs to be adopted.

Results

- Thirteen full texts and one abstract met the inclusion criteria.
- Due to heterogeneity of methods and reported data meta-analysis was not possible. Results are presented as a narrative synthesis.
- Pooling of results was used to give an overview of the population demographics and study characteristics .
- Formal statistical meta-analysis was not possible due to the heterogeneity of outcomes and reporting amongst identified studies.

Patient Demographics

- Mean ages for each group were not available due to this level of detail being omitted from some of the studies included for review.
- Adult and child recipients were not routinely described as a sub-group or reported independently in the identified studies.
- 4 studies did not report on gender[2,3,4,5] and another did not specify genders for EF and CG independently[6]. There were 239M and 250F in the EF group and 47M and 56F in the CG from the remaining studies [7,8,9,10,11,12]

The table below shows the main demographics of the combined study population:

	Total Subjects	Bilateral Implants	Unilateral Implants	Range time surgery to activation (days)	Age Range
Control Group (CG)	156	3	153	9-46	12 months - 78 years
Early Fit (EF)	596	4	592	0-14	9months - 88 years

Impedance Levels

- Impedance behaved consistently with surgical recovery for both EF and CG patients across all studies.
- Overall impedance levels were consistently observed to reduce sooner within the EF group

Magnet Strength

- The published literature has varied recommendations for magnet strength.
- In early fit cases extra care and monitoring may be required and magnet strength adjusted as necessary.
- The necessity of using an 'off ear' wearing approach was not indicated from the literature.

Complication Rates

- No significant differences were noted between the early activation and the control groups for complication rates.
- Pain and mild swelling associated with the surgical procedure were the only reported complications.
- A 0.2% early activation drop out rate was noted in one study[7].

Subjective Outcomes

- Notably reduced anxiety for patients and families due to early activation.
- Sooner access to sound and rehabilitation due to early activation.
- No significant difference in speech recognition beyond 4 weeks post-operatively.
- No long-term hearing outcomes followed up past 9 months.

Discussion

Lack of longitudinal evidence limits the conclusions for long term effects of early activation of CI.

Overlap between activation time of CG & EF groups.

Studies included were of modest methodological quality, commonly retrospective and non-randomised.

Identifying suitable patients for early activation should consider:

- Co-morbidities
- Wound healing & post-surgical factors
- Infection, pain or swelling
- Device used (e.g. off the ear processors)

Conclusions

- Early activation of CI is feasible with low complication rates.
- Early activation improves patient satisfaction and reduces anxiety.
- Patients have sooner access to sound and rehabilitation.
- Early activation of CI has the potential to reduce hospital footfall and visits; an important consideration post COVID-19.

References

1. Downs, S.H., Black, N. (1998) The feasibility of creating a checklist for the assessment of the methodological quality both of randomized and non-randomized studies of health care interventions *J. Epidemiology Community Health* **52**: 377-384
2. Alsabellha, R.M., Hagr, A., Al-Momani, M.O., Garadat, S.N. (2014) Cochlear implant device activation and programming: 5 days postimplantation. Otology & Neurotology, 35: 130-134.
3. Günther, S., Baumann, U., Stöver, T. (2018) Early fitting in cochlear implantation: benefits and limits Otology and Neurotology, 39: 250-256
4. Hagr, A., Garadat, S., Al-Momani, M.O., Alsabellha, Almuhawas, F.A. (2015) Feasibility of one-day activation in cochlear implant recipients International Journal of Audiology, 54: 323-328
5. Lin, D.P-Y., Chen, J.K-C., Tung, T-H., Li, L.P-H. (2019) Differences in the impedance of cochlear implant devices within 24 hours of their implantation PLoS ONE 14(9): 1-7
6. Diao, M., Sun, J., Tian, F., Ding, Y., Wang, Y. (2018) Cochlear implant device activation after 7 days in cochlear implant recipients European Archives of Oto-Rhino-Laryngol.276: 281
7. Wolf-Magele, A., Schnabl, J., Edlinger, S., Pok, S.M., Schoerg, P., Sprinzl, G.M. (2015) Postoperative changes in telemetry measurements after cochlear implantation and its impact on early activation Clinical Otolaryngology 40: 527-534
8. Batuk, M.O., Yarali, M., Cinar, B.C., Kocabay, A.P., Bajin, M.D., Sennaroglu, G., Sennaroglu, L. (2019) Is early cochlear implant device activation safe for all on-the-ear and off-the-ear sound processors? Audiology & Neurotology 24(6): 1-6
9. Chen, J.K., Chuang, A.Y., Sprinzl, G.M., Tung, T., Li, L.P. (2015) Safety and feasibility of initial frequency mapping within 24 hours after cochlear implantation Acta Oto-Laryngologica 135: 592-597.
10. Hu, H., Chen, J.K., Li, L.P., Chen., W.K., Huang, M., Yeh, C., Tung, T. (2019) Evolution of impedance values in two different electrode array designs following activation of cochlear implants 1 day after surgery: A study of 58 patients Clinical Otolaryngol. 45(4): 584-590
11. Hu, H., Chen, J.K., Tsai, C., Chen, H., Tung, T., Li, L.P. (2017) Evolution of impedance field telemetry after one day of activation in cochlear implant recipients PLoS ONE 12(3)
12. Marsella, P., Scorpecci, A., Pacifico, C., Resca, A., Vallarino, M.V., Ingrosso, A., Lucherti, S. (2014) Safety and functional results of early cochlear implant switch-on in children Otology & Neurotology 35: 277-282
13. Roux-Vaillard, S., Pineau, A., Laccourreye, L., Boucher, S. (2019) Immediate activation after cochlear implantation: Preliminary Study European Annals of Otorhinolaryngol. Head and Neck diseases 137(1): 17-20
14. Sun, C-H., Chang, C-J., Hsu, C-J., Wu, H-P. (2019) Feasibility of early activation after cochlear implantation Clin. Otolaryngol. 44(6): 1004-1010