IS COCHLEAR IMPLANTATION THE NEW TREATMENT FOR DEMENTIA?

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• background
  • population predictions; deaf population
  • association hearing loss & cognitive decline
  • impact of cochlear implantation
  • additional benefits - health & QoL impacts
  • birmingham study
• conclusion
ELDERLY
WHAT IS ELDERLY?

- 10th C - ‘Elder’: in a wider sense, a predecessor; one who lived in former days (Oxford English Dictionary)
- (of a person) old or ageing (OED)
- rather old; especially: being past middle age (Merriam-Webster)
- United Nations: >60  WHO: >65
- most papers: >65
nearly identical to that projected in the other less developed countries (71 per cent). Despite such rapid growth however, the least developed countries collectively are projected to account for just 6.3 per cent of the global population aged 60 years or over in 2030 and 8.9 per cent in 2050, up from 5.8 per cent in 2015.

In 2050, two out of every three oldest-old persons will live in developing regions. The cohorts born during World War II will enter their 80s during 2015-2030. Because fertility was depressed during the war, resulting in smaller birth cohorts, the population aged 80 years or over is projected to grow more slowly over the coming 15 years than over the previous 15 years. In the more developed regions, the number of oldest-old persons grew by 62 per cent over the previous 15-year period, from 37 million in 2000 to 59 million in 2015, but it is projected to grow by 44 per cent over the next 15 years, reaching 85 million in 2030. The number of oldest-old persons residing in the less developed regions in 2000, 34 million, was very similar to the number in the more developed regions. However, the population aged 80 years or over is growing faster in the less developed regions than in the more developed regions: it increased by more than 92 per cent between 2000 and 2015 and is projected to grow further by 76 per cent between 2015 and 2030. Consequently, the world's oldest-old persons are increasingly concentrated in the developing regions, from 49 per cent in 2000 to 53 per cent in 2015, and that proportion is projected to rise further to 58 per cent in 2030 and to 71 per cent in 2050.

The number of oldest-old persons in the least developed countries nearly doubled between 2000 and 2015, from 2.4 million to 4.8 million persons aged 80 years or over, and their number...
ELDERLY POPULATION

• 2015 Worldwide: 1 in 8 were >60y (901 million)
• by 2030: 1 in 6 (1.4 billion) - outnumber children aged 0-9y
• by 2030, elderly = >25% of population in Europe & USA
• >80yr: fastest growing group - triple by 2050 to 434 million

Figure II.19. Maps of percentage of population aged 60 years or over in 2000, 2015 and 2050


Note: The boundaries and names shown and the designations used on this map do not imply official endorsement or acceptance by the United Nations. Dotted line represents approximately the Line of Control in Jammu and Kashmir agreed upon by India and Pakistan. The final status of Jammu and Kashmir has not yet been agreed upon by the parties. Final boundary between the Republic of Sudan and the Republic of South Sudan has not yet been determined.


Source: UK Office for National Statistics
PEOPLE AGED 90 AND OVER IN THE UK, 1986 TO 2016

Source: UK Office for National Statistics
HEARING LOSS
>5% global population (360 million) have disabling hearing loss [328 million adults; 32 million children]

Deafness and hearing lost, WHO, February 2017

By 2030, adult onset hearing loss = one of top 10 disease burdens

WHO 2006

By 2031, 14.5 million (20%) in UK will have hearing loss

Hearing Matters, Action on Hearing Loss, DoH 2011

By 2031, 10 million adults in UK have hearing loss (45,000 children) 1:6 of UK population

Action on Hearing Loss, DoH 2015

Of Global Population, 0.9% are profoundly deaf

Limingi et al. 2015

65 million

71% of >70y have hearing loss

Action on Hearing Loss, DoH 2015

855,500 severe-profound adults in UK

Action on Hearing Loss, DoH 2015

2/3 of >70y have clinically meaningful hearing loss

PREVALENCE OF SEVERE AND PROFOUND DEAFNESS

- Adult data: Davis, Hearing in Adults, 1995, ISBN 1-897635-40-0
DEMENTIA
DEMENTIA

• prevalence projected to double every 20 years

• 2050: 100 million

  • 1:85 worldwide $^{1,2}$

• interventions delaying onset by 1 year

  ➤ 10% decrease in global prevalence in 2050 $^3$

1. Ferri CP et al. Lancet 2005  
HEARING LOSS & COGNITIVE DECLINE
HEARING LOSS & COGNITIVE DECLINE

• hearing loss independently associated with poorer cognitive functioning and dementia

• Cognitive scores 24% lower in individuals with HL

• HL associated with 41% greater rate of cognitive decline cf. normal hearing

• every 10dB HL at baseline associated with incremental additional rate of decline

HEARING LOSS & COGNITIVE DECLINE

- mechanisms
  - poor verbal communication
  - increased isolation
  - increased cognitive load
  - environmental deafferentiation
HEARING LOSS
&
OTHER FACTORS
ECONOMICS

• HL associated with higher total medical expenditures
  - $3.1 billion extra (US, 2010) ¹

• NHS costs per year:
  • Depression - £520m pa
  • Dementia - £16,700-37,500 per person affected ²

HL vs COSTS & UTILISATION

• untreated HL

  • higher healthcare costs (46.5% vs no HL)
  • increased readmission (44%)
  • more patient stays & ED visits
  • longer hospital stay

  • average $22,434 more over 10-year period than patients without HL

QUALITY OF LIFE

• “excellent QoL”: 39% with HL cf 68% normal hearing

• “fair or poor health”: 33% with HL cf 9% no HL

• HL: source of loneliness, isolation, and decline in social activities, as well as communication disorders and dissatisfaction with family life

• HAs:

• HHIE: reduced psychological, social & emotional consequences

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ACCESS & BENEFITS

• Only 6.7% of UK adults with profound HL are implanted \(^1\)

• perceived improvements in communication, confidence, education and employment, independence and family life after implantation \(^2,3\)

1. Raine et al 2013  
3. Ng et al 2016
COCHLEAR IMPLANTATION AND COGNITIVE FUNCTION
COGNITIVE FUNCTION AFTER CI

• 6 cognitive tests (MMSE, FWT, clock-drawing test, verbal fluency test, d2 test of attention, TMT- A&B)

  • pre-CI: 25% = normal in all 6
  
  • post-CI: 40% = normal in all 6

<table>
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<th>normal cognitive tests</th>
<th>Pre-CI %</th>
<th>Post-CI %</th>
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<table>
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Can cochlear implantation improve neurocognition in the ageing population?

M3: attention
Recall: short-term memory
n-back: working memory
Flanker: inhibitory abilities for stimuli
OPSAN: working memory
Trail A&B: processing speed & executive function
Verbal fluency: long-term memory

Figure 3 Mean performance IE prior to implantation (t1) and at 6 months (t2) and 12 months (t3) postimplantation for n=20 subjects.

Note: Parentheses with * indicate significance of p<0.05.
Abbreviations: IE, inverse efficiency; OSPAN, operation span task.
COCHLEAR IMPLANTATION AND DEPRESSION
CI & DEPRESSION

• QoL - NCIQ
  • significant improvements in all 6 domains

• Depressive symptoms - Geriatric Depression Scale
  • no depression: 59% pre-CI  ➔ 76% post-CI
CI & QoL

• significant improvements post CI:
  • improved speech understanding
    • significant improvement 0-6 months post CI
    • no significant improvement 6-12 months
  • ‘sensory abilities’ QoL ➔ significant increase
  • improved autonomy, executive planning & working memory

CI & QoL

Figure 4 Mean scores for the Nijmegen Cochlear Implant Questionnaire prior to implantation (t1) and at 6 months (t2) and 12 months (t3) postimplantation for n=20 subjects. Note: Parentheses with * indicate significance of p<0.05.

# Midlands Hearing Implant Programme (Adults), Birmingham, UK

<table>
<thead>
<tr>
<th>Name</th>
<th>Title</th>
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<tr>
<td>Rupan Banga</td>
<td>Surgeon</td>
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<td>Will Brassington</td>
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<td>Stuart Burrell</td>
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<td>Clinical Scientist &amp; Manager</td>
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<td>Gill Currier</td>
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<td>Charlie Huins</td>
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<td>Richard Irving</td>
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<td>Tracy Wright</td>
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MIDLANDS HEARING IMPLANT PROGRAMME ACTIVITY (ADULTS)

- Surgery
- Referrals
- Maintained
AGE AT IMPLANTATION (2016-2017)
n = 102
AGE AT IMPLANTATION

n = 102
UK NICE COCHLEAR IMPLANT CRITERIA

• National Institute for Health and Care Excellence

• >90dB HL at 2 & 4 kHz (unaided)

• <50% score of Bamford-Kowal-Bench (BKB) sentence testing @ 70dB SPL

  • children: speech, language & listening skills appropriate to age, developmental stage & cognitive ability

• >80 dB HL at two or more frequencies (500Hz, 1, 2 & 4kHz)
• <50% AB word score
PATIENTS EXCLUDED FROM BKB ANALYSIS (N=32)

- Pre-lingually deaf: 13
- Medically Complex: 7
- Revision: 4
- Non-English Speaker: 3
- Non-user: 2
- Ossification / Incomplete Insertion: 1
- CI for SSD: 1
- Deceased: 1

Total: 70 patients
BKB SCORES BY AGE

Average age <65 = 49.25y

Average age >65 = 75.65y

Significant improvement:
- Pre-op ➔ Week 1
- Week 1 ➔ 3 months

No significant difference between age groups at any test interval

SERVICE EVALUATION

• questionnaire to 102 patients (2016-2017)
• Likert scale design
• 63 responses
SINCE I HAD MY COCHLEAR IMPLANT...

1. ...my hearing has improved
2. ...my confidence has improved
3. ...my social life has improved
4. ...my general health has improved
5. ...my memory has improved
6. ...my concentration has improved
7. ...I have more energy
8. ...listening is easier
9. ...I feel mentally sharper
10. ...my overall quality of life has improved
n=63
SUBJECTIVE RATING OF BENEFIT

[Graph showing median responses for different factors such as Hearing, QOL, Confidence, etc., with two sets of data points: Age < 65 and Age 65+.]
SUBJECTIVE RESULTS BY AGE

<65y

>65y
CO-MORBIDITIES

Co-morbidities  No co-morbidities

<65
35
19

>65
37
11

n=54  n=48
BALANCE DISTURBANCE

- **<65y**
  - Yes: 50
  - No: 22
  - Preop: 4
  - Postop: 32
  - n=54

- **>65y**
  - Yes: 47
  - No: 17
  - Preop: 1
  - Postop: 31
  - n=48
CONCLUSIONS

• Between groups:
  • No significant difference in performance
  • No difference in subjective scores
  • No significant difference in comorbidities or complications

• Improvement in subjective benefits in CI, including
  • QoL
  • Confidence
  • Social
  • Mental sharpness
  • General health
  • Concentration

• Elderly patients gain equivalent benefit from CIs as younger patients
CONCLUSION

• 0.9% global population are profoundly deaf

• by 2050, 1:85 of world population will have dementia

• HL associated with 41% greater rate of cognitive decline cf. normal hearing individuals

• CI decreases cognitive load, improved attention, concentration & executive function, leading to improved cognitive function

• CI improves communicative capacity & performance and autonomy

• CI reduces depressive symptoms & significantly improves QoL
THANKS

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thank you