



Overcoming developing-world challenges in cochlear implantation: A Nigerian perspective

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Abstract

The emergence of cochlear implantation (CI) in the mid-20th century was a transformation to the field of restorative otology. The advance in this field has not been felt in lower-income countries where a huge burden of profound hearing loss lies. The authors sought to review the literature on the practice of cochlea implantation in Nigeria. Following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) extension for scoping reviews, we conducted a scoping review of the literature on CI in Nigeria. All observational studies with information on cochlear implants and/or implantation in Nigeria were included with no limitations on outcomes. The authors extracted the following data; age, sample size, sex, aetiology, outcome, type of devices, complications, challenges and the location of the surgery. The results were pooled and reported as frequencies and percentages. Three studies were utilised in this review. The study included 25 patients. The age of the identified patients ranged from 1.2 months to 63 years. There were slightly more males than females (52% males). The most common aetiology of deafness in the participants was following a febrile illness (40%), followed by deafness post-meningitis (24%). The challenges identified included high cost, lack of full rehabilitative facilities and staff, scepticism, and lack of funding. CI remains the most effective for those that are profoundly deaf. Although successful CI programmes exist in Nigeria, the number of implant programmes and the affordability are not yet commensurate to the needs of the entire Nigerian population.

Keywords: Cochlear implant, developing world, hearing device, implantation

Introduction

The emergence of the cochlear implant in the mid-20th century was a transformation to the field of restorative otology. Not only has the technology undergone various modifications and advancements in design and function, but the surgical technique has also evolved with time to minimally invasive techniques; this includes promising prospects of robotic-assisted cochlear implantation (CI) surgery and image-guided surgery^[1–3]. The advance in this field, however, has not been widely felt. The burden of hearing loss weighs disproportionately on low and low-middle-income countries, accounting for 4/5th of the global

HIGHLIGHTS

- The emergence of cochlear implantation in the mid-20th century was a transformation to the field of restorative otology.
- The advance in this field has not been felt in lower-income countries where a huge burden of profound hearing loss lies
- The most common aetiology of deafness in Nigeria was following a febrile illness (40%), followed by deafness post-meningitis (24%).
- The challenges identified included high cost, lack of full rehabilitative facilities and staff, scepticism, and lack of funding.

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disabling hearing loss; these resource-constrained health systems have poorer access to technology and surgical intervention in contrast to the first-world healthcare systems^[4–6].

It is estimated that over 430 million persons in the world are living with disabling hearing loss, the majority of which live in developing countries like Nigeria^[4]. A good number of these disabling hearing impairments are potentially salvageable with the use of cochlear implants. However, the accessibility to these in developing countries is slim as opposed to the developed world^[7]. Some reasons have been put forward for this disparity. A paper reported cost-effectiveness in low-resource settings as a limiting factor to extending and establishing cochlear implant services in the developing world^[8]. Governments of developing countries often neglect hearing loss services which ultimately worsen the disproportionate burden of disabling and profound hearing

loss^[8]. Furthermore, people who may benefit from cochlear implants in developing countries have limited access to this technology because of the restrictive and ambiguous selection criteria that are used in many centres^[7].

While recognising the healthcare disparities even among low-income countries, this paper sought to comprehensively review the literature on the practice of cochlea implantation in Nigeria (a Sub-Saharan country with a resource-poor health system managing a rapidly rising population), to identify the experiences of different centres, and bring to light the challenges that we face. Furthermore, we aim to go a step further to propose feasible recommendations to improve these challenges.

Methods

Eligibility criteria

All studies, including case series and case reports, with information on cochlear implants and/or implantation in Nigeria, were included with no limitations on outcomes. The following articles were excluded: articles that did not include data on cochlear implants/implantation from Nigeria and studies that were not reported in English. The following study types were also excluded: literature reviews, meta-analyses, abstract-only articles, conference proceedings, randomized control trials and letters to the editor.

Search strategy, information sources

Following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA, Supplemental Digital Content 1, <http://links.lww.com/MS9/A252>) extension for scoping reviews, we conducted a scoping review of the literature on CI in Nigeria. A protocol was not registered for this study. An extensive search of the PubMed and MED-LINE databases was performed by two reviewers to identify articles published on the subject from January 2000 to July 2023. The review study was conducted from June 2023 to July 2023. We optimised the search strings to capture as many papers from all African countries, before screening down to papers from Nigeria. The search strategy was devised by the authors and further improved by a librarian. The search strategy is seen in the supplementary file, Supplemental Digital Content 2, <http://links.lww.com/MS9/A253>. This ensured that no relevant papers in the literature were missed. To supplement our search, a secondary search was carried out on Google Scholar and African Journal Online.

To ensure all relevant papers were captured in our review, we performed manual cross-checks of the bibliography of identified papers for additional and potentially relevant studies. The papers were uploaded to Rayyan.ai, where deduplication, title and abstract screening, and full-text screening took place.

Charting the data and result synthesis

We created a data extraction form to extract the basic characteristics of the studies we identified. This included; age, sample size, sex, aetiology, outcome, type of devices, complications, challenges and the location of the surgery. The results were pooled and reported as frequencies and percentages.

Results

Nine hundred twenty-nine studies were identified from our primary search. Seven hundred ninety-one remained following deduplication. Seven hundred seventy-one studies were excluded following title and abstract screening. Twenty papers were eligible for full-text screening. Four studies which met the eligibility criteria were originally identified^[9-12]. Two studies, however, were from the same author and had some patient repetition, as such, the most recent study of the two was used^[11,12]. This meant that three studies were utilised in this review study^[9-11] (Table 1). In total, 17 studies were excluded. The reasons for exclusion included: Full text in Portuguese (*n* = 1), duplicate population (*n* = 1), reports experience from non-Nigerian countries (*n* = 15). The PRISMA flow chart summarises the entire review process (Fig. 1).

The study included 25 patients in total (Table 1). The age of the identified patients ranged from 1.2 months to 63 years. There were slightly more males than females (52% males). The most common aetiology of deafness in the participants was following a febrile illness (40%), followed by deafness post-meningitis (24%). Other causes included congenital deafness, post-measles, post-traumatic, autoimmune, post-cerebral palsy and idiopathic deafness^[9,10] (Table 2).

Of the 25 persons who underwent cochlea implantation, 92% experienced improvement in hearing. The MED-EL devices were the most common device that was used (68% of cases), followed by the ienjoysound(ies) device. 60% (*n* = 15/25) of the CIs were done in Nigerian centres while the rest were done in the United States (Table 1). All patients had rehabilitation (Table 1). Only one complication was recorded (development of post-implantation meningitis)^[10]. Another patient lost her external processor and did not have access to a new one^[11].

Challenges were reported in two papers^[9,10]. These include; High cost, lack of full rehabilitative facilities and staff, scepticism, and lack of funding^[9,10]. In one paper, the cost was quoted to be as high as 11 million NGN (14 295.00 \$)^[12]. Many of the cases were done as a charity or with the support of the government^[10,12]. It was uncommon for patients to be able to afford the surgery without some form of assistance^[10]. Poor rehabilitative facilities were also a source of impairment as some patients had to travel abroad for proper rehabilitation, despite them having their surgeries in Nigeria^[10].

Table 1

Summary of studies.

References	Type	Sample size	Males	Females	Type of device	Surgery in Nigeria	Surgery in the United States	Rehabilitation
Amusa <i>et al.</i> ^[9]	Case series	8	5	3	ienjoysound(ies)—250 m	8	0	Yes
Adoga <i>et al.</i> ^[11]	Case series	15	7	8	MED-AL	5	10	Yes
Suleiman <i>et al.</i> ^[10]	Case report	2	1	1	MED-AL	2	0	Yes

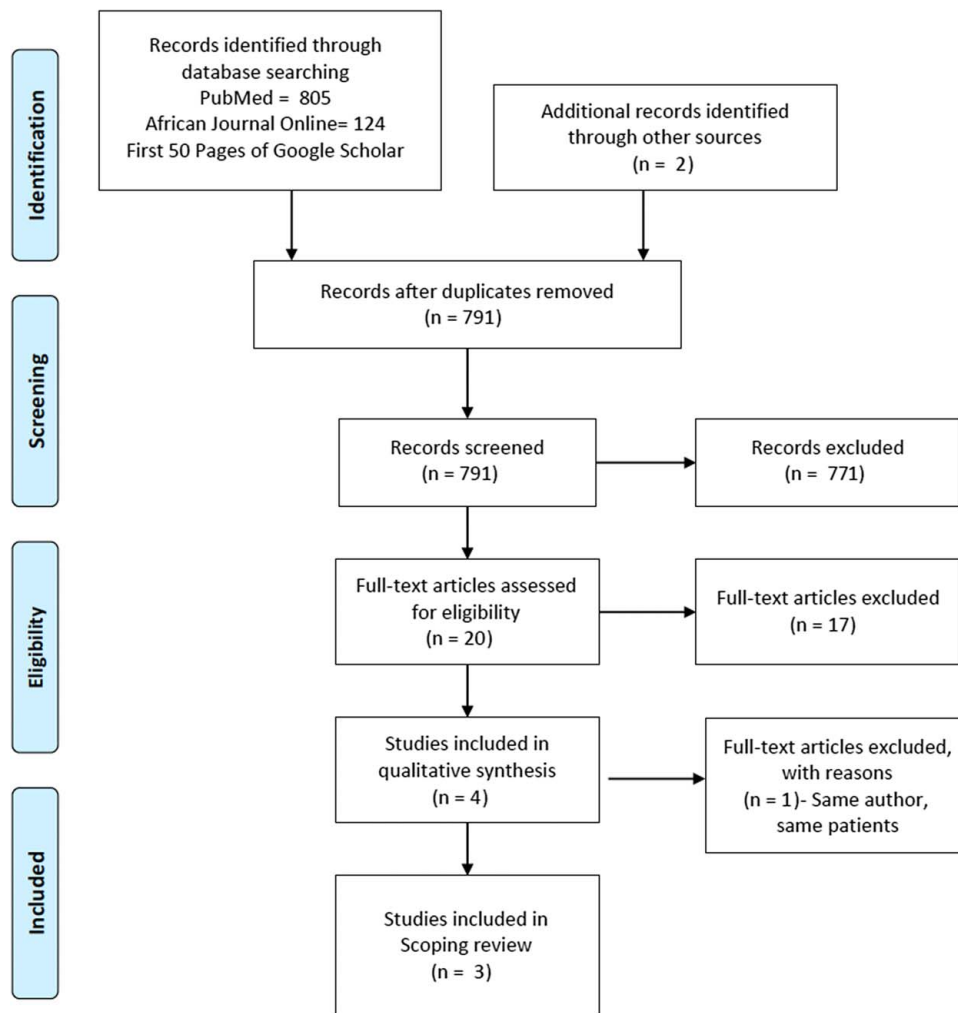


Figure 1. Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) flow chart.

Discussion

CI is a very effective means of restoring hearing to persons who have lost their hearing and has been largely popular in developed countries^[13–15]. In Africa, cochlear implants are very popular in Egypt and South Africa^[16,17]. It has also been pioneered in less developed African countries like Libya and Malawi^[18,19]. Our review explores the experiences of different centres with CI in Nigeria. There is a gross paucity of literature on this topic, possibly because there are only a handful of centres that can perform this procedure. Considering the fact that the population is more than 150 million, and 23.7% of Nigerians have been quoted to have some form of hearing impairment, this is a cause for concern^[20].

Similar to findings in other studies^[21–23], our review identified deafness in more males than females. Unlike a study conducted in Brazil where the majority of the cases of deafness were idiopathic^[24], our review found that the majority of the cases were due to febrile illnesses, and meningitis. Meningitis is endemic in Nigeria^[25], and a known complication is deafness. In Nigeria, also, children are prone to a lot of febrile illnesses for example malaria. These could explain the reason for the difference in aetiology. The majority of participants who had CI had improvement in hearing. There are a couple of reasons for this. Because of the paucity of funds, many of the cases were funded by charity, and as such, careful patient selection would have been carried out to ensure that those with the best chance of

Table 2
Aetiology of deafness.

References	Congenital	Post-measles	Post-traumatic	Post-meningitis	Post-febrile illness	Post-cerebral palsy	Uncertain/idiopathic	Autoimmune
Amusa <i>et al.</i> ^[9]	1	1	1	1	2	1	1	0
Adoga <i>et al.</i> ^[11]	0	1	0	3	8	0	2	1
Suleiman <i>et al.</i> ^[10]	0	0	0	2	0	0	0	0

improvement would be offered the procedure. Furthermore, some of the procedures were done at established neurotologic centres in the United States, affording the highest standards of care.

The majority of the devices used were from a collaborative effort from an Austrian-based company—MED-EL^[26]. Cochlear implants cost thousands of dollars^[27] and are not likely to be affordable to the average Nigerian. Most of the healthcare payments in the country are out-of-pocket and the national health insurance only covers 4% of the population and does not cover expensive procedures such as this^[28]. The devices are also not accessible as they have to be imported over long distances and this is often based on demand. Cost remains a major challenge and hurdle, as identified by our review. Furthermore, the lack of adequate rehabilitative facilities is also another problem. Rehabilitation involves setting up a studio, operating the implant, mapping the implant and fine-tuning over a period of time^[9]. Although initial mapping is usually done in foreign centres, when patients return to the country, they are often laden with problems such as travelling long distances, unstable networks and rescheduled visits^[9]. In another study, the patients had to stay in the United States for 6 months because the local centres had no personnel that could carry out the rehabilitation^[10].

The lack of rehabilitation facilities and manpower is a serious problem that must be addressed. Without adequate continuous rehabilitation, the outcome of the CI is likely to be remarkably impaired and may lead to suboptimal results. Furthermore, if patients who are beneficiaries of charity organisations have to stay for up to 6 months after surgery, this will increase the costs per person, and will ultimately reduce the amount of people that are able to benefit from the charity organisation. The cost of CI is astronomically high and has been quoted to cost between USD 40 000 to USD 60 000 for procurement and surgery^[29]. At the moment, without a collaborative charity effort, it is near impossible for this procedure to be paid for (out-of-pocket) by the Nigerian patient^[11]. Infrastructure, power supply and theatre design are also problems to consider. A constant uninterrupted power supply is important^[30] especially when performing high-end surgeries like CI. In Nigerian teaching hospitals, however, it is not uncommon for there to be prolonged periods of power outage, even during surgeries^[31]. These are problems that need addressing before CI programmes can be sufficiently established across the country.

Despite the limitations, we propose some recommendations. With regard to staff, one centre was able to sponsor the training of an auditory-verbal rehabilitation therapist. Such initiatives are welcome and are established ways of developing manpower given the resource constraints. This method has been used in Egypt previously with success^[32]. It is our recommendation, therefore, centres with ENT departments begin to consider sponsoring the training of a select member of staff with regard to auditory rehabilitation. This will allow these hospitals to begin to establish a thriving department, as well as cater for a growing body of Nigerians with cochlear implants. Telemedicine is also an important tool that can be harnessed. With the use of a proper internet connection, it may be possible to engage in tele-rehabilitation from experts who are not domiciled in the country. This should not replace the need for staff on the ground, however. This has already been trialled in a Nigerian centre^[12].

Efforts must be made by the Nigerian government to further expand and improve the National Health Insurance scheme to be

able to cover these procedures for those that need it. The teaching hospitals must also be upgraded to the right infrastructure and they must be able to maintain uninterrupted power supply for the sake of patient safety during procedures. Government initiatives may also go a long way to alleviating the financial burden on patients. These solutions are unlikely to be achieved in the short term, and it may very well be that we would remain dependent on the goodwill of charity organisations and philanthropists. The existing CI programmes in the country must continue to be sustained with a plan for expansion. Efforts should be made to create more centres as well as to create awareness among the Nigerian population concerning CI being a sustainable solution to hearing loss. This is likely to reduce the time to presentation and will improve the chances of improvement following eventual CI^[10].

We had a few limitations. We did not find a lot of studies that reported on CI, which in turn led to a really small sample size, and is unlikely to be representative of the entire population. The reason, however, is likely to be due to a lack of CIs being performed, as opposed to a lack of publication. Due to the limited nature of the studies, we were unable to investigate further with the aim to conduct a comprehensive meta-analysis. This paper will, however, be an important addition to the literature from the perspective of a developing country in Africa.

Conclusion

CI remains the most effective for those that are profoundly deaf. Although successful CI programmes exist in Nigeria, the number of implant programmes and the affordability of implantation are not yet commensurate to the needs of the entire Nigerian population. More work must be done to improve access to CI, reduce cost, and expand the capacity of the current programmes. By overcoming the preliminary challenges that have already been identified, we will ensure a better quality of life for the growing population of patients who have profound hearing loss.

Ethical approval

Ethics approval was not required for this review.

Consent

Informed consent was not required for this review.

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Author contribution

D.J.: conceptualization, methodology, screening of data, data extraction, formal analysis, writing—original draft, writing—review and editing, project administration, visualisation. O.O. and E.E.: methodology, screening of data, data extraction, formal analysis, writing—original draft, writing—review & editing.

Conflicts of interest disclosure

All authors hereby declare that there are no competing interests.

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This paper was not registered.

Guarantor

Damilola Jesuyajolu is the Guarantor.

Data availability statement

Data are available upon reasonable request from the corresponding author.

Provenance and peer review

This paper was not invited.

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