



Minimally Invasive Cochlear Reimplantation Case Report and Technical Considerations

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Abstract

There is a growing number of individuals undergoing minimally invasive surgery for Cochlear Implantation (CI). Due to device failures and other reasons there is also a growing necessity to perform cochlea reimplantation in such patients. We describe the Bremen approach: the first minimally invasive CI reimplantation accommodating the implant revisions and reimplantations.

Keywords: Cochlear reimplantation; Minimally invasive; Bremen approach; Mastoidotomy; Ear surgery

Introduction

In the last three decades Cochlear Implantation (CI) was established for the treatment of severe to profound hearing loss and deafness. Recently the indication has been extended to Single-Sided Deafness (SSD) [1].

The stepwise development of a minimal incision CI approach and its clinical introduction started more than a decade ago in pediatric cases [2]. A rising number of groups perform minimally invasive implantations in children and adults [3-5].

There exist no concise descriptions or case series about minimally invasive cochlear reimplantations in these patients. In this paper we report the first case of a Minimally Invasive CI Reimplantation (MICIR). For the intervention we applied the Bremen Approach (BA) [6].

The Bremen approach consists of four obligatory features:

1. 25 mm straight retroauricular incision
2. Mastoidotomy of less than 20 mm²
3. Round window insertion
4. Temporal implant fixation in pocket with a bony well and a bony groove for the electrode and its fixation with a suture

Materials and Methods

A 77 year old male patient who had undergone minimally invasive CI in November 2015 with a MedElMI 1200 synchrony device and a standard electrode due to bilateral progressive profound hearing loss presented in January 2018 in our department due to technical device related problems.

In 2015 the operation had been performed minimally invasive using the Bremen approach [6]. The postoperative course after implantation was uneventful. The device worked without problems. Open speech recognition of 70% monosyllables was reached within the first year.

At the time of presentation the wife reported that two weeks earlier he had bumped his head against a heater and subsequently speech recognition had gradually faded. One year prior to this event he had developed symptoms of early Alzheimers disease.

The ENT inspection showed an insignificant small hematoma at the location of the implant. Radiography and computed tomography showed no fractures. The technical device check-up confirmed a device failure.

Due to the upcoming neurological problems the patient and his wife voiced an urgent desire for a swift exchange of the CI device. Since the patient was already operated in a minimally invasive fashion (Bremen approach, Figure 1), our aim was to apply the same technique for reimplantation.

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Figure 1: Retroauricular scar before reimplantation.

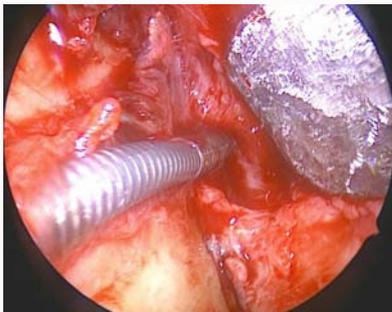


Figure 2: Implant receiver wrapped in scar tissue.

Using the original incision scar for reopening the mastoid cavity, the fibrous tissue around the implant was removed and the receiver/stimulator was mobilized (Figure 2 and 3). The mastoid cavity and the round window region were released from its fibrous tissue. Then the electrode was taken out of its bony groove and the remaining fixation suture was dissected. Subsequently the electrode and the receiver were removed from the cochlea and the temporal pocket with the bony well respectively. There was no need to enlarge the width of the former incision and the diameter of the well and the bony canal since we used the same implant type for the replantation (Figure 3).

The CIR of the new device was uneventful and required 62 minutes of operation time including intraoperative audiological testing in total (ART, ECAP, stapedius reflex). The wound closure was performed with fibrin glue (Figure 4). The postoperative course was uneventful. No complications occurred. Wound healing and device function were normal. The postoperative audiogram showed a hearing threshold at 65 dB and speech recognition of 10% monosyllables after 6 weeks. After three months the hearing threshold was between 30 dB to 45 dB and 40% monosyllables at 65 dB were reached.

So far no problems or complications have occurred.

Results and Discussion

Minimizing incisions for cochlear implantation was first introduced in pediatric cases [2]. Subsequently a number of groups further developed this approach and refined it stepwise by first introducing minimal mastoidectomies/mastoidotomy, then finding a safe way to secure the receiver/stimulator in the temporal area and finally trying round window insertion all without additional technical means such as navigation [3,7-9].

Recent alternative minimal approaches comprised endoscopic and robotic techniques. Up to now robotic surgery is not for routine



Figure 3: Explanted CI.



Figure 4: Wound at closure.

use because of the technical equipment, the costs and the time consumed by the procedure [10-14].

Since the number of minimally invasive cochlear implantations is steadily growing there is also an increasing likelihood of the need for reimplantation. The number otologic surgeon's familiar with minimally invasive surgery is limited. Most tend to or need to enlarge the approach because of presumed or factual difficulties and complications.

Minimally invasive reimplantation using exactly the same approach as in the first surgery has so far not been described yet.

The BA was developed by our department in 2014/15. In clinical applications it proved to be a safe and reliable technique in the hands of an experienced otologic surgeon [6].

Relative contraindications are anatomical variations such as a prominent bulbus vs. jugularis and the lack of pneumatization of the mastoid because these instances can significantly impair orientation and/or prevent round window insertion [15].

Because of the advantages such as minimal trauma, reduced operation time and earlier discharge from the hospital it became the routine procedure in our department for children and adults alike in feasible cases [6,16]. It can always easily be enlarged to a conventional approach if necessary.

In the literature minimal invasive cochlear implantation does not necessarily comprise all the features described in the Bremen approach. This is especially true for the round window electrode application [17]. That part is a surgically demanding task since in a minimal mastoidotomy/mastoidectomy as we perform with a diameter routinely of <math><10\text{ mm}^2</math> requires a precise knowledge of the patient's individual anatomy to achieve sufficient overview of the round window region in such a limited approach.

We felt that a cochlear implantation without round window application can be hardly labeled minimally invasive since the cochlear trauma in cochleostomy is often much more pronounced as are the postoperative problems such as vertigo and tinnitus.

Some researchers do not secure the implant to a bony well at all or use other means such as a titanium mesh to secure the implant from migration [18,19]. Also resorbable mesh and plates were used [20,21].

In minimally invasive cochlear implantation the complication rate was found between 12.5% and 10.5% [16,17]. In a recent series with more than 1000 patients it was reported as low and 2.6% [22].

The overall complication rate in conventional cochlear implantation in series with more than 500 cases is shown to be between 7.0% to 20.7% [23,24].

The rate of CIR in the latter series was between 3.5% and 0.2% in literature [17,18,22]. A minimally invasive approach for replantation procedure was not described. It must be assumed that a conventional standard approach was applied in these reimplantations or at least an extension of the initial minimal approach, such as Black reported [5,18].

Minimally invasive cochlear implantation has a lower complication rate as reported in the literature. Wound problems are very rare [3]. A significantly shorter operating time could be repeatedly demonstrated [8,9]. In a study directly comparing minimally invasive with conventional CI approach the operating time could be shown significantly shorter at the first group at an although statistically non significantly lower complication rate in the minimally invasive group [25].

Some authors report operating times of 30 minutes for minimal access surgery [18]. Shelton et al. demonstrated that about an hour can be consistently reached in normal anatomy [20]. This correlates with our experience and other reports [6,8].

Patients have little pain and can be discharged earlier from the hospital. The approach also has a cosmetically and psychologically beneficial effect contributing to high patient satisfaction [3,15].

Conclusion

Cochlear reimplantation is a common but fortunately rare instance in CI patients. It is even much rarer in cases that underwent at first a minimally invasive operation. So experience is very limited. Thus, to our best knowledge we performed in our case the first minimally invasive CI replantation. The case demonstrates that minimally invasive cochlear replantation is also possible with a favorite outcome. The Bremen approach was feasible in the demonstrated case. The result is stimulating and encourages staying less invasive than in the past also in such situations.

This widens the possibilities for atraumatic otologic surgery. More experiences and further clinical studies with more cases are necessary to develop a clinical algorithm when and if minimally invasive approach is feasible for implantation as well as for reimplantation.

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