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Veria Operation

II. Surgical Results from 101 Cases

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Key Words

Cochlear implantation · Non-mastoidectomy technique · Trans-canal wall approach · Veria operation · Surgical results

Abstract

The 'Veria operation' is a new technique for cochlear implantation. It is a non-mastoidectomy technique and uses the endaural approach for the cochleostomy and a direct tunnel drilled through the supero-posterior bony canal wall for the electrode. Two special instruments have been developed for this technique: a special perforator for the drilling of the direct tunnel and a safety electrode forceps for the insertion of the electrode. The method has been used in 101 cases with an age range from 2.5 to 75 years. 78 of them were primary operations and 23 revision cases. From the revisions, 18 were surgical failures and 5 were device failures. There were two complications: in 1 case there was a thick skin flap, which was corrected under local anesthesia, and in 1 malformation case there was a retrograde insertion to the vestibule and the posterior semicircular canal, corrected 6 weeks later. The analysis of the results shows that this method has certain advantages, which are: it is simple and therefore the learning curve is fast; it is safe for the facial nerve, as the drilling is precisely controlled by the special perforator; it produces minimal bone trauma and due to fast healing, it permits early fitting a few days after operation; it is suitable for the difficult and revision cases and it can be used for very small children where the mastoid may have not been yet sufficiently developed.

Introduction

The Veria operation for cochlear implantation differs from the classic surgical approach [1–3] in that this technique uses a trans-canal approach to the middle ear and the cochlea and a direct tunnel is drilled through the postero-superior bony canal wall. This tunnel is used as the pathway for the active electrode, which is then absolutely protected from being in contact with the canal skin. The new technique was first presented in 1997 and published in 2000 [4]. For details, see Part I in this issue. Similar non-mastoidectomy techniques have been described by Kronenberg et al. [5] and Häusler [live demonstration during workshop, Bern, 2001, unpubl. data].

Material and Method

Patients

We used the 'Veria technique' in 101 cases of cochlear implantation on patients aged 2.5–75 years. There were 78 primary cases and 23 revisions. From the revision cases, 18 were previous surgical fail-

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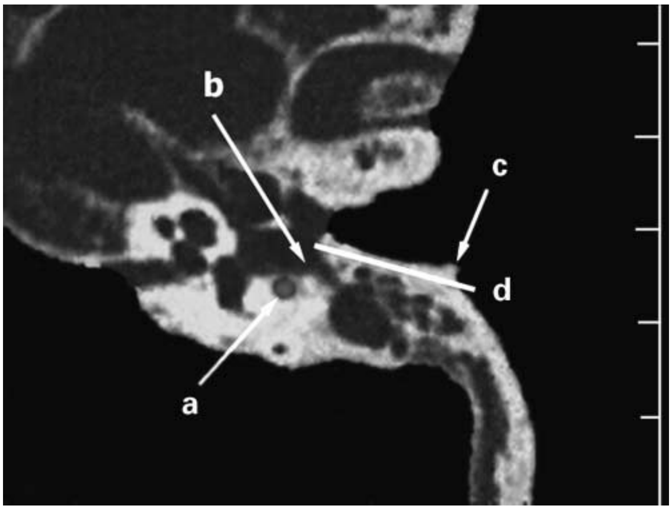

Fig. 1. High-resolution CT scan: the existence of sufficient space for the safe drilling of the direct tunnel can be predicted preoperatively: (a) facial canal, (b) facial recess, (c) Henle's spine and (d) direction and place of drilling the direct tunnel.

ures operated elsewhere with the classic technique and 5 were revisions for device failure. From the surgical failures, in 13 cases a misplaced electrode was found, most probably because the cochlea was not correctly identified due to the limited exposure through the posterior tympanotomy. In 5 cases the implantation was not completed. In 4 of them the cochlea was not found through the posterior tympanotomy, due to superior-posterior rotation of it ('empty promontory' cases). In 1 case a major vessel was opened during primary operation and the middle ear was packed to control bleeding. Of 5 device failure cases, 2 were revisions for broken device (Med-El) due to head trauma. In 1 case there was an electrode failure in a 10-year-old girl (Med-El) 3 years after implantation, where the electrode was palpable, lying under the post-auricular skin and the child liked to play continuously with it by palpating it. In 1 case there was a coil failure (Nucleus) due to bending of the device inside a cyst protruding on the head. The contraction of the fibrous encapsulation distorted and bent the implant since the Nucleus device was soft and bendable. The formed cyst was suppurated. In 1 case (Clarion) there was a broken electrode at the point of the junction with the shaft.

Operation

The steps of the operation are: (1) endaural approach to the middle ear with elevation of a tympanomeatal flap, (2) inspection of the middle ear anatomy, (3) straightening of the postero-superior bony canal wall, (4) cochleostomy, (5) drilling the suprameatal hollow, (6) drilling the trans-wall direct tunnel, (7) alignment of the tunnel to the cochleostomy, (8) extension of the skin incision and preparing of the flaps, (9) creating the bed and fixing device, (10) insertion of the electrodes, (11) manipulating the excess of the electrode, and (12) closing.

Highlights for the drilling of the direct tunnel are: (1) Direction: from the uppermost point of the supero-posterior canal wall to the cochleostomy. This oblique direction is very important for two reasons: (a) to create a tunnel almost parallel to the long process of the incus, approaching the basal turn of the cochlea at a very closed angle, almost the same as with the posterior tympanotomy but with a much wider view, and (b) it moves the line of the drilling higher from the point of exit of the chorda tympani increasing safety for this nerve. (2) Depth of drilling: most superficially, preserving <0.5 mm of thickness of the cortex. This is achieved by the special perforator and makes the cover of the canal eggshell thick, which is almost transparent. This superficial drilling combined with the width of the tunnel (1.6 mm) makes the total depth of the drilling 2 mm maximum, meaning that the tunnel is drilled through the thickness of the canal wall. This is very important for the safety of the facial nerve, since no irregularity where the nerve is growing into the canal wall has ever been reported. Another maneuver for the protection of the facial nerve is the use of an angulated elevator in the facial recess during drilling of the direct tunnel. (3) In case there is any dehiscence of the cover of the tunnel, this can be closed with bone dust. (4) The existence of sufficient space for a safe drilling of the direct tunnel could always be predicted preoperatively on the HRCT scans [4] (fig. 1). This, in combination with the inspection of the middle ear and facial nerve anatomy during operation, could identify any facial nerve or cochlea irregularities.

Results

We were able to successfully implant or re-implant all the cases, using the Med-EI devices, Combi-40/Combi-40+ in 93 cases, Combi-40 Short (condensed) in 4 cases and Combi-40 + Split GB in 4 cases. The follow-up range was from 6 months to 7 years. In a malformation case the electrode was inserted retrograde in the vestibule and from there into the posterior semicircular canal. This case was revised four weeks later and the electrode was properly inserted in the scala tympani. In another case there was a thick skin flap, which was corrected 3 months later under local anesthesia. In 5 (42.7%) out of the 13 revisions with a misplaced electrode, the initial device got damaged and it had to be replaced. The implants were switched on 2–10 days postoperatively and they all functioned well.

Discussion

The main reason for which the mastoidectomy-posterior tympanotomy approach was introduced in cochlear implantation was to create a safe pathway for the electrode, avoiding any contact with the canal skin, which most probably produced complications in the beginning of cochlear implantations. From the literature it seems that this approach is safe and successful for the vast majority of the cases [6–8].

According to our material the revision cases are not so rare in cochlear implantation. The analysis of the revi-

Table 1. Features of two approaches: endaural approach and posterior tympanotomy

Endaural (canal) approach	Mastoidectomy-posterior tympanotomy
Ready, offered by nature	Laborious, dangerous
Wide visibility-accessibility, possible safe inspection of the anatomy	Keyhole visibility, restricted accessibility, limited possibility for safe inspection of the anatomy
No removal of healthy bone	Removal of healthy bone
No change of the anatomy of the air-cell system	Dramatic change of the anatomy of the air-cell system
No scar formation in the mastoid, no affection of aeration	Possible scar formation and creation of non-aerated cavities (potential infection foci)
No impact on growth in children	Impact on growth in children
All anatomic variations of the cochlea can be handled	Difficult to handle cases with anatomic variations of the cochlea
Cases with hypoplastic mastoid cavity easily handled	Cases with hypoplastic mastoid cavity difficult to handle
No foreign body material left in the mastoid, mastoiditis can be treated as in non-implanted individuals	Foreign body material (electrode shaft) left in the mastoid, possible influence in treating mastoiditis
Pathway for the active electrode has to be additionally created	Pathway for the active electrode ready

sions shows that in most of the cases a misplaced electrode was found and this could be only due to the poor identification of the basal turn of the cochlea in the primary surgery.

Our until now unfinished anatomical study of 35 temporal bones showed that the position of the cochlea shows significant variations in relation to the facial nerve, the oval window and the major vessels [unpubl. data]. In some extreme cases the cochlea appears to be rotated supero-posteriorly, behind the facial canal, leaving the promontory flat. We called those cases 'empty promontory' cases. This may explain the difficulty to handle some cases through the narrow opening of the posterior tympanotomy.

Comparing the two approaches (table 1), the endaural approach seems to have some advantages, especially in small children. The degree of the development of the mastoid and the lateral scull base growth are not longer factors to be considered when the endaural approach is used.

When the endaural approach is used for the above-mentioned purposes, the importance of the mastoidectomy-posterior tympanotomy is restricted to a simple pathway for the electrode.

We used the thickness of the postero-superior bony canal wall to drill a direct tunnel for this purpose. The HRCT study [4] (fig. 2) showed that the existing space is sufficient for the safe drilling of a direct tunnel, without any danger for the facial nerve. Precision in drilling the direct tunnel is assured with the use of the special perforator, which has been developed for this technique. The drilling is done very superficially, precisely restricted within the thickness of the canal wall and it is safe for the facial nerve, since no irregularity of the facial nerve has been reported where the nerve grows into the bony canal wall.

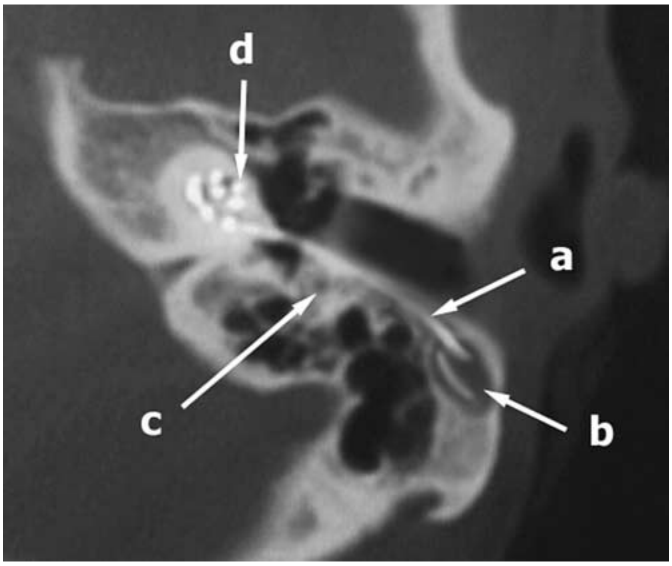

Fig. 2. The postoperative situation on a CT scan image: (a) the electrode cable runs in the direct tunnel, which is very superficial; (b) the suprameatal hollow accommodates the excess of the electrode; (c) the facial canal is far from the tunnel, and (d) real deep insertion with a Med-El electrode. The first contact approaches the apex. Notice the undisturbed middle ear and mastoid air cell system anatomy and function.

Kronenberg et al. [5] in the SMA approach described a similar tunnel drilled higher, in the superior (suprameatal) part of the bony wall. The electrode enters the middle ear between incus and malleus. Häusler preferred an open grove drilled on the posterior canal wall, combined with the fixation of the shaft of the electrode with bone cement and covered with canal skin.

Regarding the case of the retrograde insertion of the electrode into the vestibule, it was due to the wider angle of the tunnel with the scala tympani in that case. Following the highlights for the direction of drilling of the direct tunnel, as well as step 7 (alignment of the tunnel to the cochleostomy), creates a close angle of the tunnel to the cochleostomy, facilitating the proper insertion of the electrode.

The analysis of the results and our experience show that this method has certain advantages, which are: it is simple and therefore the learning curve is fast; it is safe for the facial nerve, as the drilling is precisely controlled by the special perforator and protector; it produces minimal bone trauma and due to fast healing, it permits early fitting a few days after operation; it has been proven suitable for difficult and revision cases and it can be used for very small children where the mastoid may have not been yet sufficiently developed, though the facial recess has grown. It does not affect the normal anatomy and function of the middle ear, the additus ad antrum and the mastoid air-cell system and there is not any foreign body material left in the mastoid which could produce problems in case of an infection.

Conclusions

The 'Veria technique' for cochlear implantation is a non-mastoidectomy technique using the endaural approach for the cochleostomy and the trans-canal wall approach for the electrode. It is an effective tool to improve surgical results in cochlear implantations, because it provides certain advantages: (1) It is simple and the learning curve is fast. (2) It is safe for the facial nerve. (3) It produces minimal trauma and therefore (a) the healing is faster and (b) the postoperative complications are reduced. (4) It is a suitable method for difficult cases because it offers a wide visibility and accessibility to the middle ear structures, and therefore it (a) reduces the surgical failures and (b) reduces revision operations and reduces cost (the risk factor for the device to be damaged during revision was 41.7% in our series). (5) It is a suitable method for very small children, where the mastoid may not have been yet sufficiently developed, as no mastoidectomy and posterior tympanotomy is needed and furthermore, it leaves the anatomy, the physiology and the growth of the temporal bone unaffected.

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