Salvage of Extruded Cochlear Implant By Interposing Pericranial Flap

Ahmed Khalaf Jasim*, Tawfeeq Waleed Tawfeeq, Hamed Mahmood Mohammed Alnakeeb*****

ABSTRACT:

BACKGROUND:

Cochlear implant has become a routine procedure for management of severe sensorineural hearing loss. Cochlear implant extrusion is one of the most devastating complication of this procedure. A double layer closure of pericranial flap and scalp rotational flap has being showed to decrease the rate of late implant extrusion.

OBJECTIVE:

The purpose of this study is to evaluate the use of the pericranial flap as second layer coverage after cochlear implant extrusion.

PATIENTS AND METHODS:

Eight patients with cochlear implant extrusion in Al-Shaheed Gazi Al-Hariri hospital were operated on by using two layer closure ; the pericranial flap as salvage layer used to cover the cochlear implant and scalp rotational flap as a routine coverage, with mean postoperative follow- up period of 6 months.

RESULTS:

Eight patients with late cochlear implant extrusion where operated on by using double layers closure, seven of them had no evidence of extrusion during the 6 months follow-up period. No complications were notice apart from one case who developed flap necrosis and the implant was removed later on, and another patient who had postoperative hematoma, which was surgically evacuated and the flap healed uneventfully. The results show that using pericranila flap as salvage second layer coverage in patients with cochlear implant extrusion had significant role in prevention of secondary cochlear implant extrusion.

CONCLUSION:

We concluded that the use of combination of pericranial flap as first layer with scalp rotational flap as secondary coverage of implant had superior result in prevention of secondary cochlear implant extrusion.

KEY WORDS: cochlear implant, pericranial flap, scalp flap.

INTRODUCTION:

The pericranium is the source of multiple, dependable, well-vascularized flaps, which are of use to reconstructive surgeons for multiple defects of the face and skull. The pericranial flap consists of the periosteum of the skull and its overlying loose connective tissue. This well vascularized tissue is useful as a local flap that can be used for obliteration or coverage of bony defect of skull and facial skeleton. Coverage can be provided for bone graft or prosthesis as well as soft tissue augmentation. [(1)]

Pericranium Anatomy:

The layers of the scalp can be separated from each other, liberating sheets of tissue that can facilitate reconstruction.[(2)]

The layers of the forehead and scalp are similar from superficial to deep, they include skin, subcutaneous tissues, epicranieal aponeurosis or muscle, loose areolar tissue, and pericranium.[(3)]

The combination of loose connective tissue and periosteum is collectively considered as the pericranium. Histologically, the periosteum consists of two layers of adjacent tissue. An outer layer comprises primarily of fibrous connective tissues as well as numerous blood vessels and nerves. The inner layer containing numerous dense, elastic fibers which is less vascular and more cellular, in youth the periosteum is comparatively thick and well vascularized.[(4)]

It was stated that blood supply of the pericranium is derived from the main arteries that supply the scalp. [(4,5)]

The major vessels of the scalp lie predominately in the fibro-fatty tissue immediately superficial to the galea.

*Department of Surgery , Collage of Medicine, Baghdad University.
** Shaheed Ghazi Hospital\Medical City.
***Department Surgical Specialization Hospital\Medical City .

Latex Injection studies of fresh cadavers have revealed multiple perforating vessels that extend perpendicular from the galea to the pericranium. In the pericranium those vessels form extensive interconnecting network that is supplemented directly by axial vessels and occasional perforators arising from the calvarium. To preserve as many of those perforating vessels from the galea the surgeon should leave wide base on all pericranial flaps and dissect the pericranium from the galea only as much as it is necessary to allow rotation of the flap. [1]

Although this type of flap is thin, its vascularity is very good (unless comprised by trauma, previous surgery or radiotherapy). [6,7,8]

The uses of the pericranial flap:

Pericranial flaps based on the supraorbital and supratrochlear vasculature have previously been used with significant success for separation of intra-cranial and extra-cranial space after major reconstruction efforts in the head, neck and anterior skull base.[9]

More recently reports advocate the use of pericranial flap for advanced frontal sinus operations, by using the pericranial flap as obliteration for the fontal sinus. [10,11,12]

Multilayer reconstruction of an anterior cranial fossa floor defect with an alternating long subgaleal fascia-pericranial flap based on temporalis muscle was also used in complex defect in the face or anterior cranial fossa.[13]

Unilateral pericranial flap can be used to repair defects in the medial orbit and upper lateral nasal area, allowing excision of the malignant tumors from the upper septum and ethmoid area. [14]

In case of traumatic scalp wound with large area of osseous exposure, in which re-implantation with micro-anastomosis is impossible, use of pericranium flap allows the creation of large flaps without the need of previous delay even a 5:1 ratio can be planned, because of its great vasculature through periosteal arteries. Because of the good vitality and uniform surface of such flaps, they constitute an ideal bed for skin graft. [15]

The pericranial flap also can be used to cover cochlear implant in cases of flap dehiscence and extrusion. Cochlear implant is a device that bypass a nonfunctional inner ear and stimulate the hearing nerves with pattern of electrical current so that speech and other sounds can be experienced by profoundly deaf people. [16]

PATIENTS AND METHODS:

A total number of 8 patients with cochlear implants extrusion were referred to plastic and reconstructive department in Al-Shaheed Ghazi Al-Hariri hospital . Those patients were previously implanted with cochlear implant device at temporal region, it titanium implant incased inside silicone rubber cover. Postoperatively they developed collection of seroma at site of implanted device during variable periods from surgery, later on they ended with flap necrosis with extrusion of implanted device.

The age of patients (5-10 years), photographs were taken pre and postoperatively for all of the patients.

Preoperative measure:

For those patients with small defect over the device, trial of conservative measures were started, which included: wound swab, local wound care, systemic antibiotic, and weekly observation. None of these patients get benefit from conservative treatment and they were planed later on for surgical treatment. Preoperative routine investigation were done including hemoglobin level, prothrombine time, partial thromboplastine time .

Surgical Technique:

General anesthesia is administered to the patient, in supine position, and with head tilted to other site according to the side of the defect.

Intraoperative hair shaving and sterilization is done, and the defect is outlined with methylene blue ink, and with infiltrated of 5 ML of 2% xylocaine with adrenaline 1:200,000. Marking should included a rim of normal skin around the defect to debride necrotic and unhealthy granulation tissue around the defect, after excision of the edge of defect, marking of the scalp flap is done and size is measured according to the defect. Usually planning the flap should be started from edge of the defect and extended to almost the vertex so that wide base flap is obtained which is based on the posterior occipital artery in all of cases. The flap is incised and undermining is done in loose aleolar tissue. After that the pericranium adjacent to the defect, and beneath of the flap is dissected by blunt dissection carefully from the calvrarial bone and rotated so that it will act as first layer to cover the cochlear implant and was fixed in its place by 4\0 polyglactin suture (figure A). The scalp flap is rotated as a second layer to cover the cochlear implant(figure B), the nonstre tchable scalp can be made to cover a large area by scoring the galea perpendicular to the direction of tension, scoring is done by using scalpel or electrocautery , great care must be taking to avoid injuring the vessels in supragaleal plane . Making sure that suture line should not lie immediately adjacent to each other to reduce the chance of wound dehiscence. Before closure ,the region is washed with povidine iodine .

Figure A: Elevation of the pericranial flap as first layer coverage.

Figure B: Scalp rotational flap as second layer coverage.

Bipolar electrocautery was used during the surgery in order not to interfere with implant polarity. Corrugate drain is used in some of cases.

The parents were instruct not to allow their children to sleep on the operative side.

After 24 hr , the dressing is changed and the drain is removed, hematoma collection are evacuated if present. Injectable third generation cephalosporine antibiotic (the dose according to the body weight of patient) is used for two days, and then patients are switched to oral antibiotic till stitches removal usually at 14th postoperative day.

RESULTS:

Eight patients with scalp flap dehiscence and extruded cochlear implant were operated by using 2 layers closure (pericranial flap as 1st layer and scalp flap as 2nd layer).

Two of the patients in this study were previously operated on by using local scalp flap only, 2 months later they developed implant extrusion again.

Age, sex, size of defect, chief complain of the patients, and the time intervals of presentation of patients after their initial cochlear device implantation are shown in the table -1 .

Table 1: Age, sex, size and defect, chief complain, and time of presentation.

No. of cases	Size of the defect	Chief complain	Time intervals of the presentation
1	2x3 cm	Serum collection	3 months
2	2x4 cm	Serum collection	2 months
3	2x2 cm	Serum collection	5 months
4	2x3 cm	Serum collection	2 months
5	3x3 cm	Serum collection	3 months
6	3x3 cm	Serum collection	4 months
7	2x4 cm	Serum collection	3 months
8	4x5 cm	Wound dehiscence and flap necrosis	1 month

Postoperative complication developed in 2 patients as shown in the table below.

Table 2: Postoperative complications.

No. of case	Postoperative complication	Time intervals
1	Hematoma	1st postoperative day
2	Wound dehiscence and flap necrosis	7th postoperative day

For the patient with hematoma, surgical evacuations of the hematoma was done and the follow up showed no further complications.

For the patient who had wound dehiscence and later on flap necrosis, implant was removed and the patient was scheduled for another implant.

DISCUSSION:

Cochlear implant has become a routine procedure in the United States and worldwide for the management of severe to profound sensorineural hearing loss[17].

The cochlear implant is an electronic device that replaces the function of the damaged or absent hair cells in the organ of Corti in the cochlea[18].

Initially wound breakdown was the most common major complication of cochlear implant surgery, as the devices were larger than what they are now, and the skin is sutured under tension. It is avoided by proper flap design and in particular, creating a flap that is adequate in size and blood supply. Nevertheless, flap necrosis with cochlear implant extrusion still can be encountered.[18]

Late extrusion of cochlear implant has been a relatively infrequent but reported surgical complication. The first and most important factor in implant extrusion is the placement of the initial incision. In all of extrusion seen in this study, the scar of initial incision was very close to or overlaid the edge of the implant where the breakdown occurred. The second factor is the pressure on the skin or the scar. This pressure may be exerted by the implant itself by either elevation of antenna portion, or by sheet bulk of the implant.[19]

Minor scalp flap complications, like flap infection require minimal treatment like topical and/or systemic antibiotics. Extrusion of device can result from local flap necrosis and infection transmitted form the mastoid. In cases in which adequately mobile, vascularized soft tissue in the post-auricular area is available, coverage of device with a local scalp flap or by occipital fasciocutaneous rotation-advancement flap[20].

Other situation may require a rotational pericranial flap to fill the defect and enhance implant coverage[21], as it was adopted in this study.

In this study eight patients with late cochlear implant extrusion (time of presentation was ranging between 1-5 months postoperatively).

Two of those eight patients were previously operated on where they had recurrent extrusion.

Early postoperative complication was seen in one of the patient who had hematoma on 1st day postoperatively and was managed by surgical evacuation of hematoma, and the flap healed uneventfully.

Only one patient out of the 8 patients, developed wound dehiscence and flap necrosis later on (1 month later) this patient had been previously operated on for recurrent extrusion and had large size defect (4x5 cm) this patient was explanted later on.

All of other 6 patients had no complication and showed no evidence of extrusion during the 6 months of follow-up period.

In a large study which was adapted by Charles W. Parkin et al.[22] ; Lousiaiana state university Medical center, Department of Otolaryngology . They reviewed cochlear corporation's database of 8665 implants in North and South America from 1984 through December 1996, it has shown that a total of 80 implants had exhibited delayed extrusion or breakdown of the skin flap over the implant that occurred one month after initial implant surgery ; those patients were surgically repaired due to skin breakdown over the edge of cochlear implant using a two-layer pericranial and scalp rotation flap technique. With this technique, the authors had a 100% success rate,

The pericranial flap , in the aforementioned study, was elevated as tuck-under pouch, it was mentioned that this method of elevation of pericranial flap has the advantage of transposing the thickened capsule from the under implant antenna, where it is detriment, to over the implant, where it provided additional protection. In our study we elevated the pericranial flap, with average size about 3 x 5 cm, in fold over technique with base to maintain its vascular supply.

We used scalp rotation flap for the outer layer. The defect was triangulate and the flap is constructed so that the leading tip will rotate around the circumference of the circle in which the triangle defect lies.

We attributed wound dehiscence and flap necrosis that occur to one of our patients to the large defect and inadequate pericranial coverage this is because of lack of sufficient pericranial layer due to fibrosis and scarring that result after of previous operation.

By combining a pericranial flap with scalp rotation flap, a double closure is provided over the convexity of cochlear implant.

CONCLUSION:

If skin breakdown and threatened extrusion do occur, good surgical principle for repair include the following:

1 - Enough skin around the dehiscence should be excise to remove poor-quality skin ,and the position of the closure line should run at least 1.5 cm beyond the edge of the implant.

2 - A wide based scalp rotation flap should be used to close defects without any tension.

3 - Pericranial flap should be used to cover the implant completely as the first layer.

The pericranial flap benefit has been described in much otolaryngologic, maxillofacial and plastic surgery literature. The benefit are due to pericranial flap unique characteristic including good flexibility and mobility , very rich blood supply from several arterial source, the design and separation of pericranial flap are easy. It is available at the surgical site and no additional surgical site or incision is required [(23)] .

Double layer closure using both pericranial flap and scalp rotational flap has proved adequate and secure coverage for treatment of cochlear implant extrusion.

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