A review of skin incisions and scalp flaps for the retromastoid approach and description of an alternative technique

William J. Kemp III, Aaron A. Cohen-Gadol

Goodman Campbell Brain and Spine, Department of Neurological Surgery, Indiana University, Indianapolis, Indiana, USA

E-mail: William J. Kemp III - wjkemp@indiana.edu; *Aaron A. Cohen-Gadol - acohenmd@gmail.com

*Corresponding author

Received: 18 August 11 Accepted: 26 August 11 Published: 12 October 11

This article may be cited as:
Kemp WJ, Cohen-Gadol AA. A review of skin incisions and scalp flaps for the retromastoid approach and description of an alternative technique. Surg Neurol Int 2011;2:143.

Available FREE in open access from: http://www.surgicalneurologyint.com/text.asp?2011/2/1/143/85984

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Abstract

Background: The retromastoid approach has been effective in exposing the cerebellopontine angle for resection of a variety of lesions, including vestibular schwannomas and decompression of cranial nerves. The following incisions and their variations have been most commonly used for the retromastoid approach: linear (and its variations, such as “lazy S-shaped”) and “C-shaped” incision.

Methods: Herein, we describe a curvilinear incision and compare its advantages and disadvantages with the other previously described incisions based on the senior author’s experience with 120 retromastoid operations.

Results: The senior author has used the curvilinear incision for the last 70 of 120 patients who underwent retromastoid operations. Of these, one patient encountered postoperative cerebrospinal fluid (CSF) leakage through the incision, requiring a repeat operative wound revision, and one patient suffered from a soft asymptomatic pseudomeningocele. Among the initial 50 patients who underwent a linear incision, one patient suffered from a CSF leakage managed with local wound care and another patient required a repeat operation for a tense pseudomeningocele. No wound breakdown or infection was encountered in either group.

Conclusions: The curvilinear incision is simple and efficient and may provide a shorter working distance and protect the suboccipital muscles and associated neurovascular bundle.

Key Words: Craniotomy, curvilinear incision, neurosurgical procedure, scalp flap, skin incision

INTRODUCTION

Accessing the cerebellopontine angle remains one of the most commonly performed surgical procedures in neurosurgery. The retromastoid approach has remained a versatile and simple route to access this region. Although a number of scalp incisions and flaps for the retromastoid approach have been previously described and most commonly employed, these incisions and flaps each have their own advantages and limitations.

The following scalp incisions/flaps and their variations have been most commonly used for the retromastoid approach: linear (and its variations, such as “lazy S-shaped”) and “C-shaped” incisions. In this article, we will review the advantages and disadvantages of each incision technique. We will then describe a curvilinear
incision with its associated myocutaneous flap and compare it with the other previously described incisions.

LINEAR RETROMASTOID INCISION AND ITS VARIATIONS

The linear incision and its variations have been the most commonly employed methods due to their simplicity and versatility. The linear incision may be simply extended superiorly or inferiorly, if necessary, to tailor suboccipital bony removal and expose the junction of the transverse and sigmoid dural sinuses. This incision is usually placed just medial to the mastoid groove.

Although easy to execute, a linear retromastoid approach inherently limits the surgical area. The resultant “bunching” of the skin and deep muscles, upon placement of the retractor parallel to the line of the incision, increases the working distance between the surgeon and the cerebellopontine angle [Figure 1]. Thus, the surgeon may often extend the incision to further pull back on the edges of the incision to keep the folded myocutanous flap out of his or her working corridor [Figure 2]. This folded myocutaneous flap is especially more problematic in cases of obese patients who harbor a substantially thicker scalp flap.

The linear incision requires dissection of the posterior neck muscles, including the sternoclidomastoid muscle, and this muscle dissection, based on our experience, often leads to an increased postoperative discomfort and long-term suboccipital headaches due to scarring and muscle fibrosis. The occipital artery and occipital nerves (neurovascular bundle) may be easily sacrificed in this incision technique, further increasing the risk of postoperative painful neuroma formation.

THE “C-SHAPED” INCISION

This incision has become popular among skull-base surgeons, partly due to its associated multilayer closure that may lead to a potential decreased risk of incisional postoperative cerebrospinal fluid (CSF) leak. The “C-shaped” skin incision is based over the pinna, and the skin flap and muscle flap are dissected in separate layers and reflected laterally and inferiorly, respectively. The advantages of this incision include the fact that the myocutaneous flap will not interfere with the working space of the surgeon as it does in the case of the linear incision. The disadvantages include a more elaborate dissection required through the subcutaneous tissues and muscle layers. The lower part of the incision places the neurovascular bundle at a significant risk. The two-layered closure is more time consuming as well.

AN ALTERNATIVE APPROACH: THE CURVILINEAR INCISION

A curvilinear retromastoid incision provides an adequate exposure of the targeted surgical area, and its base is along the suboccipital muscles as well as the neurovascular bundle and allows reflection of a single myocutaneous flap inferiorly [Figures 3 and 4]. The myocutaneous flap does not interfere with the working zone of the surgeon [Figure 5]. By reflecting the flap inferiorly and not bundling it laterally (as in the case of the linear incision), the surgeon allows a closer working distance to the target in the cerebellopontine angle. Figure 5 demonstrates how this incision may provide the advantages discussed.

This incision was initially described by Dandy[1] and has been slightly modified based on the description below.
Figure 3: A line connecting the inion to the root of zygoma should be drawn to identify the transverse sinus. A vertical line is also drawn over the mastoid groove to intersect the first line. This point of intersection approximates the junction of transverse and sigmoid dural sinuses and should be designated as the summit of the curvilinear incision. Used with permission from Aaron A. Cohen-Gadol

Figure 4: The myocutaneous flap is reflected in one layer inferiorly to be outside the working zone of the surgeon. The lines define the location for the placement of the burr hole. Used with permission from Aaron A. Cohen-Gadol

Figure 5: Illustration of a cross-section that describes the curvilinear retromastoid incision, which allows reflection of the flap inferiorly and minimizes the working distance for the surgeon. Used with permission from IU Health

Dr. John Tew (Mayfield Clinic) also brought the use of this incision to our attention.

**Nuances of the Technique for the Curvilinear Incision**

It is necessary to identify the mastoid eminence, mastoid groove, inion and the root of zygoma. A line connecting the inion to the root of the zygoma should be drawn to approximate the transverse sinus. A vertical line is also drawn over the mastoid groove to intersect the first line. We have previously demonstrated that this point of intersection approximates the junction of transverse and sigmoid dural sinuses\(^3\) and should therefore be designated as the summit of the curvilinear incision [Figure 3].

The anterior leg of the incision is made just lateral to the vertical line that defines the mastoid groove. The other leg of the incision is arbitrary based on the bony exposure of the suboccipital bone necessary for the particular lesion (i.e., a wider base incision may be necessary for a large cerebellopontine angle tumor).

The incision is completed to the level of the suboccipital bone, and the myocutaneous flap is reflected and retracted inferiorly in one layer using the appropriate-sized fishhook retractors [Figure 4].

**Advantages and disadvantages**

The curvilinear incision maximally avoids the suboccipital muscles, potentially avoids the neurovascular bundle, and is efficient as it is performed in a single layer. However, unlike the linear incision, the curvilinear incision cannot be easily extended superiorly to allow more superior bone removal to identify the junction of the dural venous sinuses if this junction is located too superiorly. In our experience, this limitation has not been a problem.

**RESULTS**

The senior author has used the curvilinear incision for the last 70 of 120 patients who underwent retromastoid operations. Of these, one patient encountered postoperative CSF leakage through the incision, requiring a repeat operative wound revision, and one patient suffered from a soft asymptomatic pseudomeningocele. Among the initial 50 patients who underwent a linear incision, one patient suffered from a CSF leakage managed with local wound care and another patient required a repeat operation for a tense...
pseudomeningocele. No wound breakdown or infection was encountered in either group.

DISCUSSION

The incision techniques described above can be reliably compared only in a randomized controlled trial requiring a large number of patients to provide enough statistical power to allow for a meaningful comparison across the three groups. Such a trial is unlikely to be performed; nonetheless, the retrospective nature of this analysis is a major limitation.

The cause of postoperative headaches after retromastoid surgery, especially for patients who undergo resection of their vestibular schwannoma through this approach, is unknown, but scarring between the muscle and dural is implicated, and coverage of the exposed dura is recommended to prevent this scarring. Dissection of the suboccipital muscle has also been implicated and should be avoided. A sizable base for the curvilinear flap should be kept in mind to avoid breakdown along the skin edges.

CONCLUSIONS

The curvilinear incision is simple, efficient, and may provide a shorter working distance and protect the suboccipital muscles and associated neurovascular bundle.

The curvilinear incision allows an adequate exposure of the suboccipital bone to the level of the posterior fossa floor. Therefore, the surgeon can open the arachnoid membranes over the cisterna magna to release CSF and relieve intracranial tension immediately after the dura opening.

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