The Enlarged Translabyrinthine and Transapical Extension Type I Approach for Large Vestibular Schwannomas

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Received: 8 July 2010 / Accepted: 10 October 2010 / Published online: 1 January 2011
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Abstract To evaluate the results obtained by performing the enlarged translabyrinthine and transapical extension type I approaches for removal of large vestibular schwannomas and those with anterior extensions. An academic tertiary referral centre at Mumbai, India. Retrospective case review. 35 patients of vestibular schwannomas having size greater than 3 cm in extrameatal diameter with extension anterior to the internal auditory canal who underwent the enlarged translabyrinthine or transapical extension type I approach and with a minimum follow up of 1 year are considered. Other subjects who underwent translabyrinthine approach but did not fulfill the above criteria were excluded. Tumor was removed completely in 34 subjects (97.1%). Anatomic interruption of facial nerve occurred in 4 cases (11.4%); 3 subjects underwent end to end anastomosis and 1 subject required a cable graft, these were done during the primary procedure itself. At 1 year follow up 28 subjects (80%) had good facial function (Grade I and II, House Brackmann Grading). Postoperative cerebrospinal fluid leak was encountered in 1 subject (2.9%). 34 subjects (97.1%) had a normal albeit slow gait by the sixth post-operative day. Complete tumor removal with a very low morbidity in our series suggest that the enlarged translabyrinthine and transapical extension type I

approach offers excellent control of the neurovascular structures in the cerebellopontine angle as also of the large vestibular schwannoma itself aiding complete removal. It also offers the advantage of management of the interrupted facial nerve at the primary procedure itself since the proximal and distal segments are in the operative field.

Keywords Acoustic neuroma · Facial nerve · Vestibular schwannoma · Translabyrinthine approach

Introduction

The classic translabyrinthine approach (TLA) described by House WF [1] involved drilling 180° around the internal auditory meatus (IAM). However, this approach was considered inadequate for removal of large vestibular schwannomas. Hence, retrosigmoid approach remained the approach of choice for removal of large vestibular schwannomas [2]. However, technical refinements to the TLA have been devised over the years [3, 4] leading to enlargement of the approach. The enlarged translabyrinthine approach (ETLA) described by Sanna et al. [5, 6] describes a wide approach all around together with drilling 270° around the IAM. The transapical (TA) extension type I also described by Sanna et al. [7] deals with large or giant vestibular schwannomas with significant anterior extension and is essentially a 300–320° drilling around the internal acoustic meatus.

The purpose of this article is to describe the steps which lead to a wider approach than used previously. We also evaluate the completeness of tumor removal and morbidity of enlarged translabyrinthine approach and the transapical extension type I for removal of tumors above 3 cm in extrameatal diameter.

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Materials and Methods

A retrospective review was performed and only clinical records of 35 subjects of acoustic schwannoma above 3 cm in extrameatal diameter, extension anterior to the internal auditory meatus and with a minimum follow up of 1 year were considered. Other subjects who underwent translabyrinthine approach but did not fulfill the above criteria were excluded. All the cases were operated between January 2004 to December 2008 at an academic tertiary referral centre at Mumbai, India. All these subjects had unserviceable hearing (speech reception threshold less than 50 db and/or speech discrimination score less than 50%) and were operated upon by the translabyrinthine approach. Data were collected in relation to completeness of tumor removal, facial nerve function and morbidity.

Tumor removal was classified as total or subtotal intraoperatively. Additionally, a contrast enhanced MRI scan was performed on all subjects for the same 6 weeks after surgery. Subtotal removal was considered even if a tiny sleeve of tumor capsule was left over the brainstem or the facial nerve. Facial nerve function was noted in the following periods: preoperative, immediate postoperative and at minimum 1 year follow up.

Surgical Technique

A detailed description of the approach has been described elsewhere [5]. However, we would emphasize the surgical steps that would ensure a large exposure.

A retroauricular C shaped incision is made from 1 cm superior to the helix to the mastoid tip. The retroauricular incision is placed 4–5 cm behind the postaural groove. This helps in good decompression of the posterior fossa dura from the internal auditory meatus up to about 1.5 cm posterior to the sigmoid sinus and including the sigmoid sinus. Bone is completely taken off from the area of the jugular bulb. If a high jugular bulb is encountered, it is gently pushed inferiorly with the periosteum using a piece of surgical and held in place with bone wax. On the superior aspect, the middle fossa dura is decompressed by completely drilling the tegmen plate. Drilling is performed between the superior wall of IAM and the middle fossa dura as also between the inferior wall of IAM and the jugular bulb to expose as much dura as deemed necessary for the access. This drilling is done parallel to the long axis of the IAM. This constitutes the drilling towards the petrous apex to expose between 270° (enlarged translabyrinthine approach) to 300° (transapical extension type I) around the IAM as seen in Fig. 1. Good control can be obtained for the anterior extension of the vestibular schwannoma up to the prepontine cistern. Opening the dura

Fig. 1 Area around the internal auditory meatus denoting the area drilled in the approaches. *TL* translabyrinthine approach, *ETL* enlarged translabyrinthine approach, *TA* transapical extension type I approach

and draining CSF helps to shrink the cerebellum and offers further access to the posterior limit of the tumor without the need for any cerebellar retraction. Superiorly, good visualization of the area of trigeminal nerve is obtained as also sometimes of the infratentorial segment of trochlear nerve without any retraction of the temporal lobe. Effective decompression of the jugular bulb inferiorly as previously mentioned helps in unhindered access to the area of the lower cranial nerves. Incising the tumor capsule and debulking the tumor helps in easier maneuverability of the tumor capsule and enables identification and preservation of neurovascular structures hidden by the tumor. Meticulous hemostasis is achieved as in any neurosurgical procedure.

Our technique of closure is slightly different than what is usually performed and forms the basis of another paper. However, principles of prevention of CSF leak are the same, namely exenteration of air cells, blockage of any remnant cells with bone wax, closure of the attic, obliteration with fascia and fat, air tight closure of musculopectoral, subcutaneous and skin layers.

The preoperative and postoperative MRI Scans of a subject are shown in Fig. 2a and b indicating large tumors can be removed via this approach. The extent of bone removal on another subject is shown in Fig. 3a and b.

Results

Of the 35 subjects, 20 were male (57%) and 15 female (43%) subjects. The ages ranged from 17 to 65 years. All of these cases were primary cases and were operated on by us for the first time. Only tumors above 3 cm in the

Fig. 2 **a** Right vestibular schwannoma—preoperative MRI scan showing extension anterior to the internal auditory meatus. **b** Right vestibular schwannoma—postoperative MRI scan

Fig. 3 **a** Left vestibular schwannoma—preoperative CT scan showing widening of the internal auditory meatus. **b** Left vestibular schwannoma—postoperative CT scan showing the bone removal in the enlarged translabyrinthine approach

extrameatal diameter with extension anterior to the internal auditory meatus were considered for the study and all these subjects underwent the enlarged translabyrinthine approach with transapical extension when needed.

Tumor was removed completely in 34 subjects (97.1%) while in 1 subject (2.9%) the tumor capsule was adherent to brainstem. This was determined by a significant drop in pulse rate time and again on manipulation and hence a small sleeve was left over the brainstem. These findings were reconfirmed by a 6 week postoperative contrast enhanced MRI on these subjects.

The facial nerve function was noted in the pre-operative, immediate post-operative and at 1 year follow up periods. House Brackmann (H–B) Grading scale was used. Table 1 summarizes the results. Pre-operatively, 4 subjects of 35(11.4%) had facial function House Brackmann Grade II. This was attributed to tumors above 4.5 cm in extrameatal

diameter who took late decision on surgery. It may be noted that our anatomic preservation of facial nerve was not good in our early cases but is presently improving with progressive experience. We inadvertently interrupted the facial nerve in 4 cases (11.4%). End to end apposition with fibrin glue (3 subjects) and interposition nerve graft (1 subject) was used in the 4 cases. Of these subjects, 3 subjects recovered to a Grade III facial nerve function at 1 year follow up whereas 1 subject had no improvement. The subject with Grade VI palsy (failure of nerve anastomosis using interposition nerve graft at cerebellopontine angle) was subjected to facial hypoglossal anastomosis much later (was Grade VI at 1 year follow up). 80% of all subjects regained functionally acceptable results between Grade I and Grade II at 1 year follow up.

We had 1 subject (2.9%) who had a small quantity of cerebrospinal fluid leaking from the incision edge noticed

Table 1 Facial nerve preservation results (Tumors >3 cm in extrameatal diameter, N = 35)

House-Brackmann grading	Pre-operative (%)	Immediate post-operative (%)	1 year post-operative (%)
Grade I	31 (88.6%)	15 (42.9%)	24 (68.6%)
Grade II	4 (11.4%)	8 (22.9%)	4 (11.4%)
Grade III		6 (17.1%)	6 (17.1%)
Grade IV		2 (5.7%)	
Grade V			
Grade VI		4 (11.4%)	1 (2.9%) ^a

^a Subject underwent VII–XII anastomosis much later after failure of anastomosis at primary surgery

in the second post-operative day. He was subjected to lumbar drainage of CSF and was kept on tablet acetazolamide for 3 days along with tight mastoid dressing and had no CSF leak subsequently.

Only 1 subject (2.9%) had IX and X cranial nerve paresis. However, it may be noted that this subject had pre-operative IX and X cranial nerve paresis which did not improve after surgery. This subject was given swallowing therapy and manages to swallow food from the side with normal function.

Subjects were mobilized on the second post-operative day and most resumed normal gait, albeit a slow walk, by the sixth post-operative day (97.1%). One subject (2.9%) took 15 days to walk without support and was left with an altered gait. This was retrospectively attributed to bipolar coagulation of one of the peripheral arterial branches supplying the cerebellum.

34 out of 35 of our patients (97.1%) were discharged by the seventh post-operative day.

Histopathological confirmation was obtained for all the cases as schwannoma.

Discussion

The translabyrinthine approach was earlier not favoured due to the limited access and line of visualization through the microscope. However, technical refinements and development of the enlarged translabyrinthine approach as also the transapical extension type I offers excellent visualization and control from the trigeminal nerve superiorly to the lower cranial nerves inferiorly and from the cerebellopontine angle posteriorly till the prepontine cistern anteriorly. This helps in dealing with large vestibular schwannomas. Our results for complete or subtotal excision of large vestibular schwannomas are comparable to those of other authors [8, 9] although, evidently, our series is smaller than their series. The only indications for subtotal removal are age in some cases of subjects above 70 years or intraoperative factors like adherence of the tumor capsule to brainstem or facial nerve.

Anatomic facial nerve preservation in our series was marginally lesser than other series [6, 8, 9]. We inadvertently interrupted the facial nerve in 4 cases (11.4%). This however happened during our first few cases. Handling of the facial nerve close to the brainstem as also use of intraoperative monitoring are critical factors to improve facial nerve preservation. The approach also offers an advantage in the sense that anastomosis of the interrupted facial nerve can be performed, since the medial end at the brainstem and the lateral end at the fundus or the porus of the IAM are directly in the operative field. We use fibrin glue for anastomosis of the interrupted facial nerve and the anastomotic site is covered using fascia, either temporalis fascia or fascia lata.

Cerebrospinal fluid leak occurred in only 1 subject in our series which settled with use of a lumbar drain. Various methods have been described to prevent CSF leaks in the translabyrinthine approach [10, 11]. We adopt a slightly different closure than those described, however, this forms the basis of another paper. The principles of prevention of CSF leak, however, are essentially the same and includes removal of all cells, sealing any remnant cells, blocking the attic and tight closure of musculoperiosteal, subcutaneous and skin layers.

Ninth and tenth cranial nerve paresis occurred in only 1 subject in our series. The incidence of lower cranial nerve paresis is probably more in retrosigmoid approach because of the stretch caused by cerebellar retraction.

We did not have any major vascular complication. The incidence of vascular complication in the translabyrinthine approach is similar to the incidence in retrosigmoid approach [12] and needs to be avoided. It needs to be stated that post-operatively if a hematoma develops, it may be simpler to drain it via a translabyrinthine route as compared to the retrosigmoid route where a swollen cerebellum may be encountered.

It may be argued that results of surgery for vestibular schwannoma are similar for the translabyrinthine and retrosigmoid approaches [13, 14]. However, it has been proved that hearing preservation results are poor using retrosigmoid approach for tumors exceeding 2.5 cm in the cerebellopontine area [15–17]. Also, subjects cannot hear

optimally in the normal ear in the presence of residual but unserviceable hearing in the operated ear (Class C and D-AAO-HNS classification). Both these are significant considerations suggesting preferred use of a translabyrinthine approach over the retrosigmoid approach in tumors above 3 cm in extrameatal diameter, especially if the preoperative hearing is unserviceable (less than 50 dB speech reception threshold and less than 50% speech discrimination score).

Conclusion

Translabyrinthine approach was once considered a narrow approach for removal of large vestibular schwannomas. However, technical refinements have culminated in the development of the enlarged translabyrinthine approach as also the transapical extension type I. It is now possible to remove large vestibular schwannomas completely with minimal or no morbidity. The fact that an interrupted facial nerve can be anastomosed easily due to distal segment of the nerve being in the operative field, the very low incidence of CSF leak, very low morbidity and consequently shorter hospital stay establish that the enlarged translabyrinthine approach and transapical extension offer a very good approach for dealing with large vestibular schwannomas and those with extension anterior to the internal acoustic meatus which were previously thought to be unapproachable via a translabyrinthine approach. The poor hearing preservation results as tumor size increases above 2.5 cm establish this procedure as an alternative to retrosigmoid approach in properly selected cases of large vestibular schwannomas.

Conflict of interest None.

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