Absence of Bone over the Geniculate Ganglion

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Dandy recognized that the geniculate ganglion “occasionally” protrudes through a congenital defect in the roof of the petrous temporal bone. In their book on trigeminal neuralgia, Stookey and Ransohoff noted that in rare instances the petrous bone is defective over the geniculate ganglion. This fact has been considered of such minor significance that it is largely disregarded in descriptions of neurosurgical procedures for treatment of trigeminal neuralgia in which the roof of the petrous temporal bone may be exposed, and it is not among the anatomical variants listed in standard anatomy textbooks, although it has been mentioned in the otological literature. House and Crabtree reported the incidence of this bony anomaly to be 5%, presumably on the basis of their clinical material. Batson stated that the geniculate ganglion is not covered by bone in early childhood.

This project was undertaken to evaluate the incidence of dehiscence of bone over the geniculate ganglion in the adult and to make available an adequate photographic display of the phenomenon.

Method and Material

At 50 autopsies, 100 adult human temporal bones were removed and examined under a dissecting microscope. The dura was removed from the bone, and the greater petrosal nerve was exposed and traced to the facial hiatus. If the ganglion and a portion of the greater petrosal nerve were embedded in bone, their covering was removed, and the length of greater petrosal nerve covered was determined. If the bony covering of the geniculate ganglion was deficient, the size of the bony defect was determined. In some of the specimens the exposed portion of the ganglion was painted, and then the bone was removed over the course of the seventh nerve. Photos were taken with the original paint intact to illustrate the extent of exposure of the nerve (Figs. 1–4).

Results

In 15 bones (15%), all or part of the geniculate ganglion and genu of the seventh nerve was found exposed (Table 1). The exposed ganglion was on the right in eight and on the left in seven; the bony defect was bilateral in five and unilateral in five. The entire genu and ganglion were found exposed in only two bones.

In 15 other specimens the geniculate ganglion was completely covered but there was no bone extending over the greater petrosal nerve (Table 2). In the remaining 70 bones the ganglion and some portion of the proximal part of the greater petrosal nerve were covered by bone. More than 50% of the specimens had less than 2.5 mm of greater petrosal nerve covered. The greatest length of greater petrosal nerve covered by bone was 6.0 mm.

Discussion

Our results show that there is significant danger of injuring the facial nerve at the time of elevating the dura from the roof of the temporal bone during surgery for trigeminal neuralgia. Facial paralysis occurs in less than 10% of the cases, an incidence that falls within limits which can be explained by direct
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There are several reasons why the absence of bone over the geniculate ganglion is not readily noted during operation for treatment of trigeminal neuralgia. When exposed by the absence of bone, the genu and ganglion do not protrude from the bony defect but remain flush with or slightly depressed from the surrounding bony surface. Also, the bony defect most often corresponds to only a portion of the diameter of the genu, the exposed portion being the same or only slightly larger than the first portion of the greater petrosal nerve, for which it may be mistaken. When such a bony defect is viewed from the side, as in the usual extradural subtemporal approach for trigeminal neuralgia, the irregularities of the floor of the middle fossa could hide it or make it barely perceptible. Because bleeding may

Fig. 1. Interior of base of skull as viewed from above. Operative defect for temporal approach to trigeminal ganglion is at right. Area from which specimens shown in Figs. 2, 3, and 4 were taken is indicated by circle (specimen for Fig. 2 was from left and for Figs. 3 and 4 from right).

trauma. The fact that the onset of facial weakness is delayed, appearing 3 to 4 days after operation, suggests that direct trauma may not be the only cause. However, the delay in onset of facial paralysis does not exclude its being caused by delayed swelling induced by direct manipulation of the genu and ganglion. In cases in which only a small portion of the ganglion is exposed, trauma could produce delayed swelling and facial paresis, while trauma to those nerves fully exposed could produce the facial weakness immediately postoperatively. Peet and Schneider noted facial weakness immediately after operation in 2.8% of their trigeminal neuralgia patients. Others also have noted its presence immediately after operation although in most instances it appeared later.
result from elevation of the dura and avulsion of the petrosal branch of the middle meningeal artery from its entrance into the facial hiatus, it is easy to understand why electrocoagulation might be used in close proximity to the exposed facial nerve. This vessel usually bleeds when the dura is elevated, and, when possible, this bleeding should be controlled by some method other than cautery to avoid injuring the facial nerve.

Previously described mechanisms for the facial palsy after subtemporal surgery are certainly important in some cases. The most widely accepted cause is traction on the greater petrosal nerve. Dixon in 1897 called attention to the danger of damaging the facial nerve in the region of the geniculate ganglion by traction on the greater petrosal nerve. Adson thought that avulsion of the trigeminal root from the brain stem rather than section of the nerve might contribute to the facial paralysis. Stookey and Ransohoff suggested that seepage of blood through the facial hiatus into the facial canal might cause pressure on the tightly enclosed facial nerve. Wilkins noted that facial nerve injury may result from coagulation of the greater petrosal nerve.

It has been suggested that traction on the facial nerve could be prevented by sectioning the greater petrosal nerve in its groove. However, this would not prevent injury by direct trauma. Direct trauma to the facial nerve can be prevented by avoiding stripping of the dura from the anterior surface of the petrous ridge, as suggested by Frazier and more recently by Poppen and Asenjo. The transdural approach, as advocated by Herrmann and Wilkins, also avoids the necessity of stripping the dura from the petrous roof. However, a facial palsy developed in two of Wilkins' patients, this being attributed to electrocoagulation of the dura in the region of the greater petrosal nerve. The facial palsy in these cases may have resulted from occlusion of the petrosal branch of the middle.

**TABLE 2**

*Length of greater superficial petrosal nerve covered by bone*

<table>
<thead>
<tr>
<th>Length (mm)</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>30*</td>
</tr>
<tr>
<td>0.1-0.9</td>
<td>8</td>
</tr>
<tr>
<td>1.0-1.9</td>
<td>28</td>
</tr>
<tr>
<td>2.0-2.9</td>
<td>14</td>
</tr>
<tr>
<td>3.0-3.9</td>
<td>10</td>
</tr>
<tr>
<td>4.0-4.9</td>
<td>8</td>
</tr>
<tr>
<td>5.0-5.9</td>
<td>1</td>
</tr>
<tr>
<td>6.0-6.9</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>

* Of these, ganglion exposed in 15 (see Table 1) and ganglion covered in 15.
meningeal artery by electrocoagulation. This branch runs with the greater petrosal nerve and enters the facial hiatus to supply the seventh nerve in the region of the genu. In addition, there is collateral circulation to this portion of the nerve from anastomosing branches of the stylomastoid and internal auditory arteries.17

Although the magnification provided by the operating microscope can aid in the visualization of this anatomical variant, as illustrated by our photographs, we think that the most satisfactory method of avoiding trauma to the facial nerve during the approach to the Gasserian ganglion is to leave the dura intact over the region of the facial hiatus. This can usually
be done by directing the surgical exposure anteriorly and medially toward the middle meningeal artery and the foramen ovale, rather than posteriorly over the roof of the petrous temporal bone. The use of cautery for bleeding vessels near the geniculate ganglion should be avoided.

Summary

One hundred adult human temporal bones were examined at autopsy, and it was found that in 15 the bone was defective over the geniculate ganglion. This defect exposes the facial nerve in the subtemporal operative field.

We have discussed various theories for the origin of facial palsy after trigeminal surgery and postulated that direct trauma to the seventh nerve may explain a significant number. The best method for avoiding this complication is to direct the initial surgical approach anteriorly and medially toward the middle meningeal artery and foramen ovale and not to strip the dura from the roof of the petrous bone.

References

11. HERRMANN, J. D. (Cited by Wilkins, H., see ref. 18).
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