

Facial Nerve Schwannomas: CT and MR Findings

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The present study was undertaken to analyze the radiologic findings of intratemporal and extratemporal schwannoma (ITS & ETS). We retrospectively reviewed the CT (9 cases), MR (3 cases) and medical records of 10 facial schwannoma patients. After classifying these into ITS and ETS, radiologic and clinical findings were analyzed. The most common clinical manifestations were facial nerve dysfunction (6/6 cases, 100%) and hearing impairment (5/6 cases, 83.3%) in ITS and parotid mass (4/4 cases, 100%) in ETS. Genuiculate ganglion (GG) was the most commonly involved segment of ITS (5/6 cases, 83.5%). On CT, ITS arising in GG (4 cases) showed erosion of the petrous bone (4 cases), cochlea (3 cases), lateral semicircular canal (1 case) and ossicles (3 cases). ITS arising in the mastoid segment (1 case) showed the destruction of the jugular plate and external auditory canal wall. All three ITS in which MRI was performed showed iso- to hypointensity on T1WI, hyperintensity on T2WI and well-enhanced on post-enhanced T1WI. ETS showed various findings, but all four ETS were located in the posterolateral portion of the retromandibular vein and extended toward the stylomastoid foramen. In conclusion, ITS shows the characteristic bony changes along the facial nerve course on CT and typical signals of schwannoma on MR. ETS shows various findings. However, if the tumor is located along the extratemporal facial nerve course, then facial schwannoma may be suspected.

Key Words: Schwannoma, facial nerve, CT, MR

Schwannomas account for about 8% of all primary tumors in the intracranial cavity; the majority originate from the acoustic nerve. The trigeminal nerve is the next most frequent site. The facial nerve is rarely involved.

The course of the facial nerve can be divided globally into three parts; intracranial (cisternal), intratemporal (intracanalicular, labyrinthine, tympanic, mastoid), and extracranial (intraparotid) (Som and Bergeron, 1991). Most authors have largely

divided facial schwannomas into intratemporal and extratemporal (intraparotid) origins (Hingorani, 1970; Balle and Greisen, 1984; Murata *et al.* 1985). The clinical picture varies with the tumor's site of origin. The main clinical findings are facial weakness or paralysis and hearing impairment in intratemporal schwannomas and parotid mass in extratemporal schwannomas (Komune *et al.* 1986). Intratemporal schwannomas cannot be differentiated from other neoplastic diseases such as congenital cholesteatoma, meningioma, glomus tumor and hemangioma by clinical manifestations only, so radiologic study is required for preoperative diagnosis (Jackson *et al.* 1980; Horn *et al.* 1981; Kienzle *et al.* 1986). It is difficult to differentiate extratemporal schwannomas from other benign parotid tumors because parotid mass is a nonspecific sign and radiography shows various presentations (Avery and Sprinkle, 1972). Failure to recognize the presence of a schwannoma

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may result in the unnecessary sacrifice of the facial nerve (Das Gupta *et al.* 1969). Especially when untreated, intratemporal schwannomas may produce conductive and sensori-neural deafness, facial paralysis, otorrhea, or serious intracranial problems by extension into the middle or posterior cranial fossae (Pulec, 1972). So early, correct diagnosis and evaluation of a schwannoma's extent is necessary to allow total removal of the tumor, preservation of normal anatomy and restoration of facial and auditory function (Pulec, 1972; Latack *et al.* 1983).

In this study, we analyzed the CT and MR features according to intratemporal and extratemporal types in 10 patients with facial nerve schwannomas.

MATERIALS AND METHODS

From March 1986 to July 1996, 10 cases of facial nerve schwannomas were surgically removed and pathologically confirmed in our hospital. We retrospectively reviewed the CT, MR and clinical findings of these cases. There were four women and six men, 22~61 years old. We largely divided facial schwannomas into intratemporal (tumors involving intracanalicular, labyrinthine, tympanic and mastoid segment) and extratemporal (tumors involving intraparotid segment) types. The main clinical findings

were reviewed in both intratemporal and extratemporal schwannomas. Two patients underwent both CT and MR, while seven patients underwent CT only. MR only was performed on one patient. CT was performed in the axial and coronal planes, following the injection of a contrast agent (Ioversol, 320mg iodine ml⁻¹; Optiray 320) on a GE 9800 scanner. One hundred milliliters of Ioversol was administered at the commencement of these examinations. Slice thickness was 1.5mm for intratemporal schwannomas and 5 mm for extratemporal schwannomas. MR scans were performed with a 1.5 T imager (General Electric Signa; Milwaukee, WI, USA). T1-weighted (TR/TE=400-600/10-20) images were obtained in the axial and coronal plane. T2-weighted images (TR/TE=2500-4000/90-105) were performed in the axial and/or oblique sagittal plane. Following the injection of Gd-DTPA (Magnevist; 0.1 mmol/kg body wt), axial and coronal sections were performed. Slice thickness was 3mm and the acquisition matrix was 256×192. We reviewed the CT and MR images of intratemporal and extratemporal schwannomas. Tumor location and shape, as well as changes in the surrounding structures according to the involved segment, were analyzed from the CT of intratemporal schwannomas.

RESULTS



Fig. 1. A 58-year-old man with facial nerve schwannoma involving the labyrinthine segment, geniculate ganglion and tympanic segment. a, b. Axial and coronal CT scans show the erosion in the region of the facial hiatus, the geniculate ganglion and slightly lateral to that position, there is erosion on the floor of the middle cranial fossa (arrows), cochlea (arrowhead) and ossicles.

The most common clinical findings in six patients of intratemporal schwannomas was facial nerve dysfunction (6/6 patients, 100%), including facial paralysis (4/6 patients, 66.7%), facial weakness (1/6 patients, 16.7%) and facial spasm (1/6 patients, 16.7%). The next most common finding was hearing impairment (5/6 patients, 83.3%), followed by ear congestion (2/6 patients, 33.3%) and tinnitus (1/6 patients, 16.7%). All four extratemporal schwannomas presented only with a parotid mass without facial nerve dysfunction. Geniculate ganglion was the most commonly involved segment of intra-

temporal schwannomas (5/6 cases, 83.5%). All five cases arising from the geniculate ganglion extended into the middle cranial fossa. We analyzed the tumor shape and the change of surrounding structures in five of the six intratemporal schwannomas in which CT was performed. Three cases extending from the geniculate ganglion throughout the labyrinthine and tympanic course of the nerve showed a fusiform shape (3 cases), destruction of the petrous bone (3 cases), erosion of the cochlea (3 cases), erosion of the lateral semicircular canal (1 case), and erosion of ossicles (3 cases) (Fig. 1). One case arising only

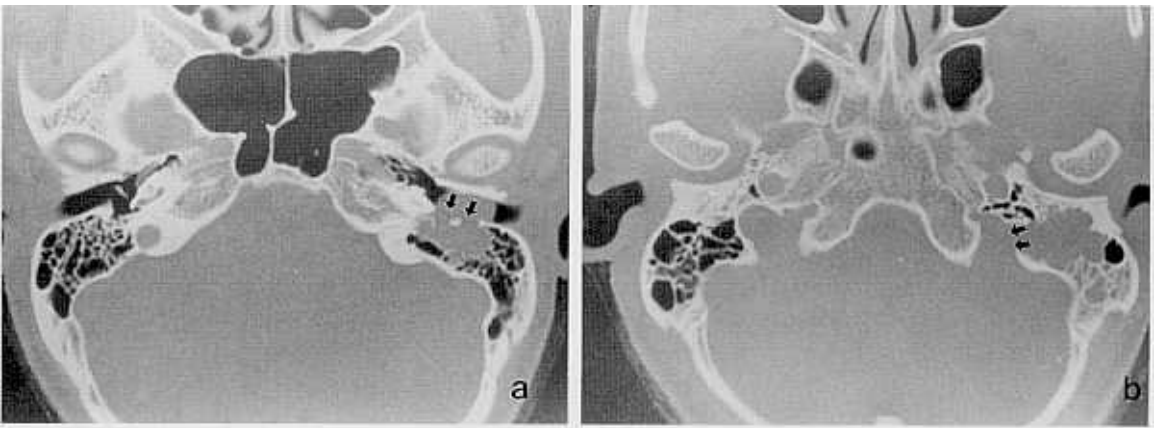


Fig. 2. A 31-year-old woman with facial nerve schwannoma involving the mastoid segment, **a.** Axial CT scan shows a lobulated mass in the mastoid with extension to the external auditory canal. There is erosion of the posterior portion of the osseous external auditory canal (arrows), **b.** Axial CT scan shows erosion of the jugular plate (arrows) due to schwannoma involving the mastoid segment.



Fig. 3. A 46-year-old woman with facial nerve schwannoma involving the intracanalicular segment, labyrinthine segment, geniculate ganglion and tympanic segment, **a.** On pre-enhanced T1-weighted axial MR image, an oval mass (arrows) located on the floor of the middle cranial fossa shows homogeneous hypointensity, **b.** The tumor extends into the internal auditory meatus (open arrow) and is well-enhanced on post-enhanced T1-weighted coronal MR image.

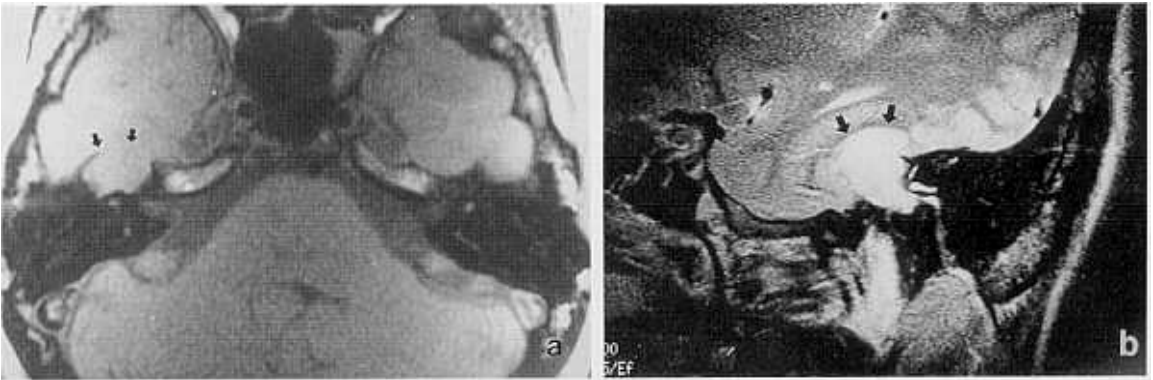


Fig. 4. A 34-year-old woman with facial nerve schwannoma involving the geniculate ganglion, tympanic and mastoid segments. **a.** The tumor (arrows) shows homogeneous isointensity on the pre-enhanced T1-weighted image, **b.** A T2-weighted sagittal oblique image reveals the mass located in the region of the geniculate ganglion (arrows) with homogeneous hyperintensity. This lesion extends down the tympanic segment of the facial nerve.

in the geniculate ganglion was cone-shaped and showed destruction of the petrous bone. One case arising in the mastoid segment showed a lobulated shape, destruction of the jugular plate, and erosion of the posterior wall of the external auditory canal (Fig. 2). All five intratemporal schwannomas on CT demonstrated homogeneous contrast enhancement and the bony margins of the lesions were relatively smooth. MR was performed in three of six intratemporal schwannomas. One case arose in the geniculate ganglion, tympanic segment and mastoid segments, another case arose in the geniculate ganglion, while in the third case, the tumor was involved from the intracanalicular segment to the tympanic segment. Among them, two cases were hypointense and one case was isointense to gray matter on T1-weighted images. All three cases were hyperintense to gray matter on T2-weighted images and were well-enhanced homogeneously after administration of Gd-DTPA (Fig. 3 & 4). All four extratemporal schwannomas were located in the posterolateral portion of the retromandibular vein and extended toward the stylomastoid foramen. Two cases demonstrated a round low-density mass with higher-density central nodules (Fig. 5). One case showed a lobulated low-density mass with irregular rim enhancement, and the other case showed a dumbbell-shaped mass with homogeneous enhancement (Fig. 6).

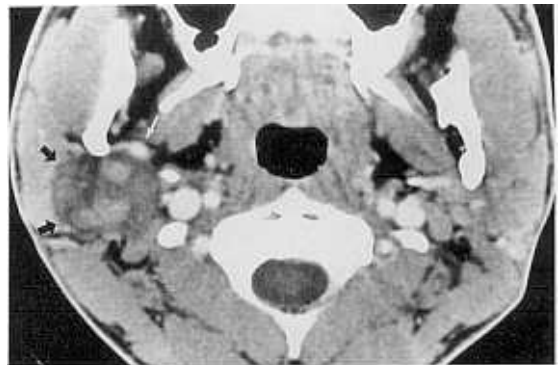


Fig. 5. A 22-year-old man with extratemporal facial nerve schwannoma. On post-contrast axial CT scan, a round mass (black arrows) is located in the lateral portion of the left retromandibular vein (white arrow). The low-density mass has higher nodular densities in the central portion.

DISCUSSION

Although schwannomas may arise from any cranial nerve, their preponderance in the acoustic nerve and less frequently in the trigeminal nerve, is well known. Facial schwannomas are uncommon lesions that can extend along the facial nerve course. Most authors divide facial schwannomas into extratemporal and intratemporal tumors (Hingorani, 1970; Balle and Greisen, 1984; Murata *et al.* 1985). Facial

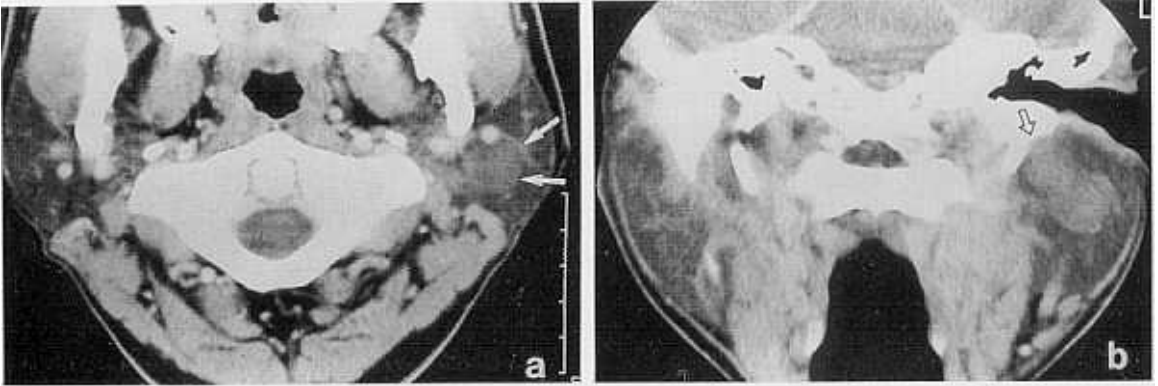


Fig. 6. A 36-year-old man with extratemporal facial nerve schwannoma, **a.** On post-contrast axial CT scan, a dumbbell-shaped mass (arrows) is located in the lateral portion of the left retromandibular vein (open arrow) and enhanced homogeneously, **b.** The lesion extends up toward the stylomastoid foramen (open arrow) on a post-contrast coronal CT scan.

weakness or paralysis and hearing impairment have been reported as the main symptoms of intratemporal schwannomas (Bailey and Graham, 1983; Komune *et al.* 1986). Intratemporal schwannomas are also occasionally accompanied by symptoms of facial spasm, otalgia, ear congestion, otorrhea and tinnitus (Anad *et al.* 1977). In this study, the main clinical findings of intratemporal schwannomas corresponded to past reports. So facial nerve dysfunction and hearing impairment are thought to be important symptoms in intratemporal schwannomas.

The preferred site of intratemporal schwannomas has been reported as the vicinity of the geniculate ganglion (Ismat *et al.* 1975; Horn *et al.* 1981; Inoue *et al.* 1987). In this study, the most common site of intratemporal schwannoma was the geniculate ganglion (five of six tumors, 83.5%), corresponding to past reports. Intratemporal schwannomas tend to spread along the path of least resistance and often involve the intracranial cavity and air spaces such as the tympanum, epitympanum and mastoid (Pulec, 1972; Komune *et al.* 1986). The characteristic destruction of the facial canal according to the segment of the facial nerve affected by a schwannoma has been described before (Ismat *et al.* 1975; King, 1990; Lidov *et al.* 1991). The erosion of the surrounding bones showed the typical spreading pattern of the tumor along the course of the facial nerve, and the bony margins of these lesions were relatively smooth, suggestive of a feature of the bone

being compressed rather than infiltrated. These findings were very helpful in the diagnosis of intratemporal schwannomas (Ismat *et al.* 1975).

In the few reports where intratemporal schwannomas appeared on MR, they were noted as hypointense to gray matter on T1-weighted images and hyperintense to gray matter on T2-weighted images with marked enhancement after administration of a contrast agent (Lidov *et al.* 1991; Som and Bergeron, 1991). The tumors in all three of our cases arose along the facial nerve course and were compatible with these MR findings.

Besides facial nerve schwannoma, the intratemporal tumors that may affect the facial nerve include primary cholesteatoma, paraganglioma, hemangioma, metastases, and perineural tumor from parotid malignancy origin. With CT alone, congenital cholesteatoma could not be distinguished from facial nerve schwannoma given its tendency to follow the facial nerve canal. However, contrast-enhanced MR would differentiate these two lesions by enhancing the schwannoma while failing to enhance this congenital cholesteatoma. Glomus jugulotympanic paraganglioma can show destruction of the jugular plate like facial nerve schwannoma involving the mastoid segment, but its tendency to involve the hypotympanum aids in the differentiation from the facial nerve schwannoma.

Extratemporal schwannoma is infrequent and generally unsuspected. The fact that these tumors

often reach a large size without neurologic deficit and show various presentations in radiography may explain the difficulty in establishing a correct pre-operative diagnosis (Avery and Sprinkle, 1972; Balle and Greisen, 1984). The main symptom of extratemporal schwannoma has been reported as parotid mass (Anad *et al.* 1977; Komune *et al.* 1986). All four extratemporal schwannomas in this study presented only as a parotid mass without facial nerve dysfunction. Because CT findings of all four extratemporal schwannomas in this study also showed different shapes, internal characteristics and contrast enhancement patterns, it was difficult to differentiate intraparotid schwannomas from other parotid tumors. However, all four extratemporal schwannomas were located in the posterolateral portion of the retromandibular vein and extended toward the stylomastoid foramen. A lesion along this course may be suggestive of a facial schwannoma.

In conclusion, intratemporal schwannomas showed the characteristic changes of surrounding bones along the facial nerve course and homogeneous contrast enhancement on CT. On MRI, intratemporal schwannomas were hypo- or isointense on T1-weighted images, hyperintense on T2-weighted images and well-enhanced on postcontrast T1-weighted images. All extratemporal schwannomas showed various shapes and internal characteristics, but extended from the posterolateral portion of the retromandibular vein adjacent to the stylomastoid foramen, suggestive of the characteristic position of the facial nerve. If the tumor is located along this extratemporal facial nerve course, then a facial nerve schwannoma may be suspected.

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