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Facial Nerve Enhancement in MR Imaging

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The significance of facial nerve enhancement after IV gadolinium administration has not been determined. We evaluated the MR appearance of facial nerves (nonenhanced and enhanced) in patients without and with masses involving the temporal bone, internal auditory canal, or cerebellopontine angle. In patients without such masses, no facial nerve enhancement was seen. In the other group, four of 11 patients showed facial nerve enhancement and geniculate ganglion masses. Three of these four patients had neurofibromatosis; one had surgical verification of a facial nerve neurofibroma. Enhanced MR facilitates identification of abnormal facial nerves.

In a study of gadolinium enhancement of extraaxial tumors, we observed enhancement in the geniculate ganglion of a facial nerve (Breger R, unpublished data). The purpose of this study was to determine the significance of facial nerve enhancement by IV gadolinium in MR imaging.

Materials and Methods

From 30 MR studies of patients who received IV gadolinium, we selected those in which the temporal bone was included in the MR images. We divided the cases into those with evidence of a cerebellopontine angle or internal auditory canal mass (group 1, tumor cases) and those without evidence of a mass involving the temporal bone, internal auditory canal, or cerebellopontine angle (group 2, "normals"). Most of the tumor cases had subsequent surgery, biopsy of the tumor, and histologic determination of the tumor type.

The pre- and postgadolinium images were compared in each group of patients. The appearance of the facial nerve and the degree of contrast enhancement were noted. Surgical and MR findings were carefully correlated.

The MR studies were performed on a 1.5-T system (GE Signa). Pulse sequences consisted of short TR (500 msec) and short TE (25 msec) images and long TR (2000 msec) images with TE of 25 and 75 msec that were performed before administering the IV bolus of gadolinium diethylenetriamine penta-acetic acid (DTPA) at 0.1 mmol/kg. The short TR and TE images were repeated 3, 25, and 55 min after contrast agent administration, and the long TR images were obtained after 8 and 30 min. For group 1, technical factors included (a) axial and coronal short TR and TE images centered at the pons, contiguous 3-mm-thick slices, 128 × 256 matrix, and two excitations (NEX 2) and (b) axial long TR images, 5-mm-thick slices with a gap of 1 mm, and 128 × 256 matrix. For group 2, technical factors—including slice thickness, section spacing, plane of section, and matrix—depended on the size and location of the pathologic process that had been detected with CT prior to MR imaging. For this paper, enhancement was evaluated in the short TR and TE images obtained 3 min after IV gadolinium.

Results

Eleven patients were assigned to group 1 on the basis of findings of internal auditory canal or cerebellopontine angle masses; 13 patients with no evidence of a tumor in or near the internal auditory canal were assigned to group 2. The group

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1 patients included five cases of neurofibromatosis and bilateral tumors and six cases of unilateral tumors.

In four of the 11 patients in group 1, enhancement was seen within the facial nerve canal. In one patient with neurofibromatosis, the horizontal segment of one facial nerve and

both geniculate ganglia were abnormal, having a lobular appearance and demonstrating contrast enhancement (Fig. 1). Two of the patients with neurofibromatosis had bilateral lobulations within the facial nerve canal involving the geniculate ganglia that enhanced with IV gadolinium (Fig. 2). In a patient

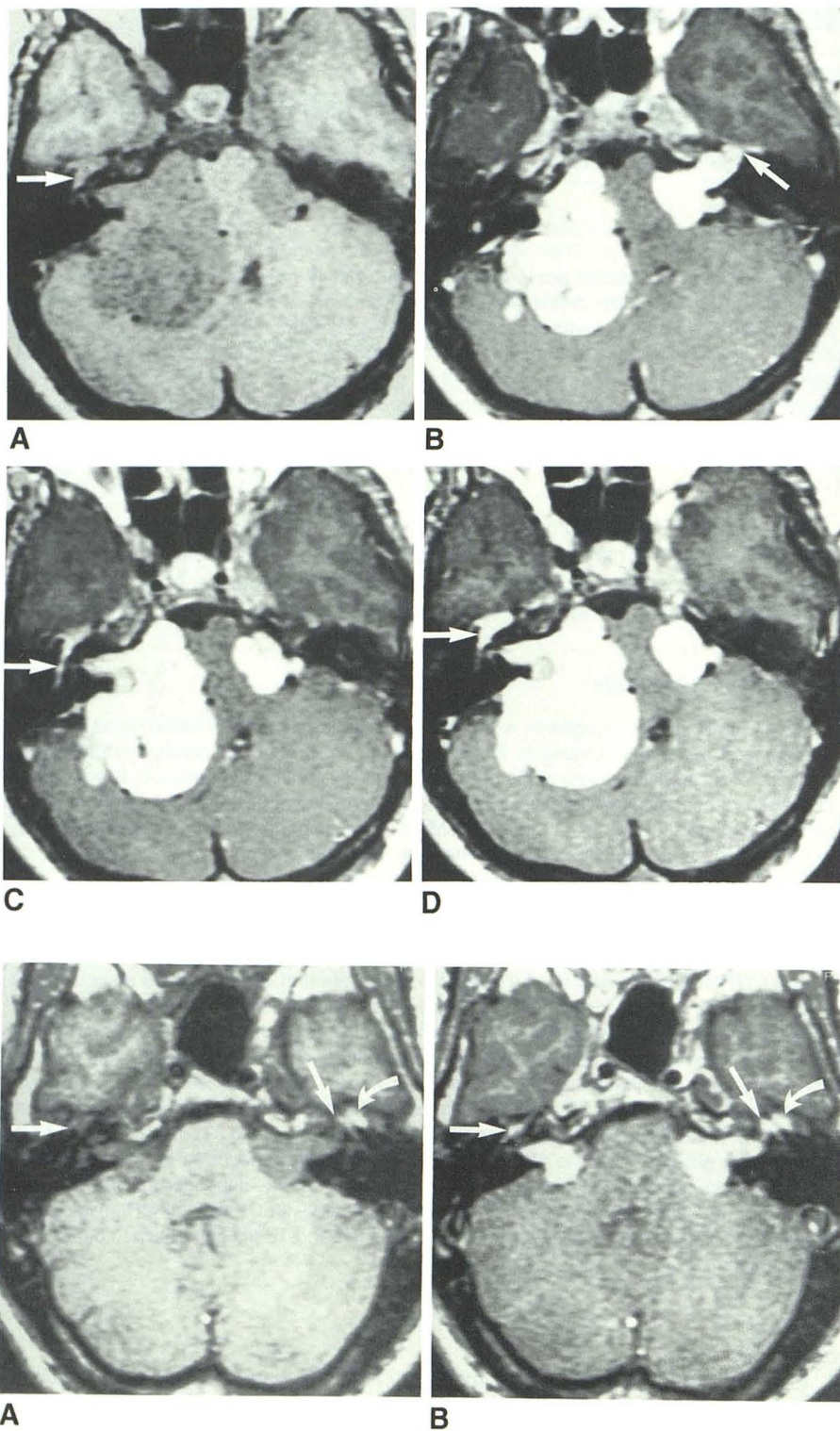


Fig. 1.—Intensely enhancing masses by geniculate ganglia and horizontal segment of right facial nerve (arrows), also involving cerebellopontine angle cisterns and internal auditory canals, are shown in axial short TR and TE MR images without (A) and with (B–D) IV gadolinium. Patient had neurofibromatosis, right facial paralysis, and bilateral hearing loss. At surgery, a right acoustic neuroma was found, but neither facial nerve canal was explored.

Fig. 2.—Intensely enhancing small lobulations by geniculate ganglia (straight arrows) and cerebellopontine angle masses are shown in axial short TR and TE MR images without (A) and with (B) IV gadolinium. Fat with high signal intensity (curved arrow) identified adjacent to left geniculate ganglion should not be mistaken for enhancing tumor. This patient with neurofibromatosis and hearing loss had bilateral abnormal facial nerve electromyogram studies. A right acoustic neuroma was confirmed surgically, but facial nerve canals were not explored.

without neurofibromatosis, a geniculate ganglion mass with enhancement was identified. The CT studies in this case confirmed the expansion of the facial nerve canal. CT studies were not available in the other cases.

All the patients in group 1 had neurosensory hearing loss consistent with acoustic neuroma. Four patients in group 1 had facial paralysis or an abnormal facial nerve electromyogram. In one of these patients, surgical exploration of the geniculate ganglion confirmed the presence of a neurofibroma invading the facial nerve distal to the internal auditory canal. The other patients had no surgical exploration of the facial nerve canal. Seven of these patients had surgical confirmation of acoustic neuroma, which was bilateral in two patients.

The MR studies in the group 2 patients showed no enhancement in the facial nerve canal.

Discussion

The facial nerve can be studied effectively with MR, even without IV gadolinium, because the nerve produces a considerably higher signal than the adjacent bone and middle ear [1-3]. With IV gadolinium, enhancement within the nerve can be studied effectively because the adjacent tissues produce little signal. Although some cranial nerves may enhance with IV gadolinium [4], in this study the facial nerve in the control group did not enhance.

Our study showed a high incidence of abnormal facial nerve enhancement in association with tumors in the internal auditory canal or cerebellopontine angle cistern, especially in patients with neurofibromatosis. The significance of the enhancement, however, is not resolved by our study. Five of six facial nerves that showed abnormal enhancement were associated with facial nerve dysfunction, either an abnormal electromyogram or facial nerve paralysis; but one had no associated symptoms. In one case, infiltration of the facial nerve was documented by surgical exploration. In three other cases, the nodularity of the facial nerve suggested tumor involvement, but surgical exploration was not attempted. Neoplastic involvement may represent invasion by an acoustic

neuroma or a facial nerve tumor. Further observations are warranted to determine the pathologic significance of the abnormally enhancing facial nerve.

This study suggests that enhanced MR is a sensitive means of detecting abnormal facial nerves (comparison with CT was not done). The study also indicates a high frequency of abnormal facial nerves in patients with neurofibromatosis. In one series, one of eight patients with facial nerve neuromas had neurofibromatosis [5]. Additional enhanced MR studies and longer follow-ups are warranted in patients with temporal bone tumors. An association between abnormal facial nerves and acoustic neuroma may prove to be more frequent than previously suspected. Facial nerve tumors commonly involve the geniculate ganglion, but at present, it is thought that acoustic neuromas rarely extend laterally and involve the ganglion [5-7].

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