

The Nervus Intermedius: A Review of Its Anatomy, Function, Pathology, and Role in Neurosurgery

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Key words

- Anterior inferior cerebellar artery
- Cranial nerve
- Facial nerve
- Intermediate nerve
- Microvascular decompression
- Neuralgia
- Nervus intermedius
- Vestibulocochlear nerve
- Wrisberg nerve

Abbreviation and Acronym

MRI: Magnetic resonance imaging



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INTRODUCTION

The nervus intermedius was first identified in 1563, and it was Heinrich August Wrisberg who named it the “portio media inter communicantem faciei et nervum auditorium” in 1777 (1). This nerve (**Figure 1**), often referred to as the Wrisberg nerve, carries parasympathetic fibers to the lacrimal and nasopalatine glands and transmits sensory information from the tongue and various skin areas of the nose and concha of the ear (8, 20, 22, 28). A cutaneous branch arises near the origin of the chorda tympani nerve and joins with the auricular branch of the vagus nerve to supply the external auditory canal and concha of the external ear. It is this innervation that allows herpetic vesicles to be identified in the ear with viral infection of the geniculate ganglion, the so-called Ramsay-Hunt syndrome (20).

■ **BACKGROUND:** Geniculate neuralgia, although uncommon, can be a debilitating pathology. Unfortunately, a thorough review of this pain syndrome and the clinical anatomy, function, and pathology of its most commonly associated nerve, the nervus intermedius, is lacking in the literature. Therefore, the present study aimed to further elucidate the diagnosis of this pain syndrome and its surgical treatment based on a review of the literature.

■ **METHODS:** Using standard search engines, the literature was evaluated for germane reports regarding the nervus intermedius and associated pathology. A summary of this body of literature is presented.

■ **RESULTS:** Since 1968, only approximately 50 peer-reviewed reports have been published regarding the nervus intermedius. Most of these are single-case reports and in reference to geniculate neuralgia. No report was a review of the literature.

■ **CONCLUSIONS:** Neuralgia involving the nervus intermedius is uncommon, but when present, can be life altering. Microvascular decompression may be effective as a treatment. Along its cisternal course, the nerve may be difficult to distinguish from the facial nerve. Based on case reports and small series, long-term pain control can be seen after nerve sectioning or microvascular decompression, but no prospective studies exist. Such studies are now necessary to shed light on the efficacy of surgical treatment of nervus intermedius neuralgia.

ANATOMY AND FUNCTIONS

The nervus intermedius consists of fibers derived from the superior salivary nucleus whose stimulation results in secretion of the lacrimal and submandibular and sublingual glands (4). Traveling along this nerve are sensory fibers derived from the gustatory receptors destined for the superior pole of the solitary nucleus in the medulla and fibers for cutaneous sensation of parts of the ear destined for the dorsal part of the trigeminal tract (31). The course of the nervus intermedius and the motor root of the facial nerve can be divided into cisternal, meatal, labyrinthine, and extracranial parts. Rhoton et al. (20) found that, on average, the length of all 3 segments was 22 mm. The nerve takes its name from its intermediate position between the facial and superior portion of the vestibular nerves (20). The average length of adherence,

which is often crescent shaped, of the nervus intermedius to the vestibulocochlear nerve has been found to be approximately 8 mm (11, 20). Inside the meatus, the motor root of the facial nerve and the nervus intermedius are usually bound together as a single structure.

In the temporal bone, the facial nerve continues its course through the facial canal. The nerve is supplied from branches of the middle meningeal, maxillary, and posterior auricular arteries. Between the cochlea and the semicircular canals, it runs laterally above the vestibule. Reaching the medial wall of the epitympanic recess, the geniculum (external genu) is formed. This point, above the base of the cochlea, is the location of the geniculate ganglion (14). Here the nerve gives rise to the greater petrosal nerve (greater superficial petrosal nerve), which carries parasympathetic fi-

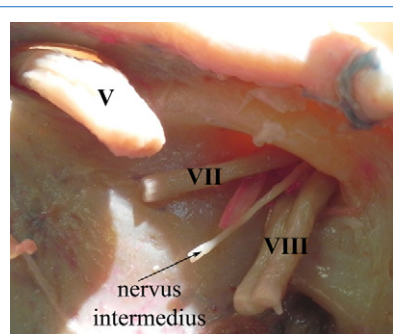


Figure 1. Cadaveric dissection of the right porus acusticus noting the facial, nervus intermedius, and vestibulocochlear nerves.

bers supplying the lacrimal, nasal, and palatine glands (22, 29). The tympanic cavity and the nerve are separated only by a thin layer of bone and this layer might be absent, so in some individuals, there is only the mucosa between the nerve and the cavity of the middle ear, and therefore the nerve might be easily affected by infections of the middle ear. Possible anomalies include the nerve lying in the wall of the mastoid antrum with the nerve emerging from the mastoid process and division of the nerve within the facial canal (branches leave the temporal bone through different foramina in this case). An anterolateral turn toward the parotid gland describes the extracranial course of the facial nerve after it emerges from the stylomastoid foramen (14, 31).

Rhoton et al. (20) and Oh et al. (16) found up to 4 to 5 roots that made up the nervus intermedius, although a single root was the most common. Additionally, Rhoton et al. (20) stated that in approximately 20% of cases, it is impossible to identify the nervus intermedius along its intracisternal course because it is intimately attached to the vestibular part of the vestibulocochlear nerve and does not separate from it until the internal acoustic meatus.

Preganglionic fibers from the superior salivatory nucleus in the pons travel to the pterygopalatine ganglion in the greater petrosal nerve, and the postganglionic fibers innervate the lacrimal gland as well as the glands of the nose and palate. Preganglionic parasympathetic fibers from the pons travel to the submandibular ganglion in the chorda tympani and innervate the submandibular, the sublingual, and the accessory salivary glands.

Section of the nervus intermedius may decrease the cutaneous sensitivity in the area around the concha of the external ear, sensation from anterior nasopharynx and tympanic membrane, part of the external auditory canal, and the area behind the ear and over the mastoid process (11, 22). Stimulation of the nervus intermedius can cause referred pain to the ear, and the projection of fibers from this nerve might also explain referred pain to the face after irritation of the nervus intermedius (20). Therefore, the nervus intermedius plays an important role in the surgical treatment of neuralgia of the external auditory canal (see later) (20). Interestingly, Ashram et al. (6) described electromyography activity in the orbicularis oris muscle after stimulation of the nervus intermedius.

Burmeister et al. (8) conducted a study in which they tried to identify the nervus intermedius with 3-T magnetic resonance imaging (MRI). Their conclusion was that the nervus intermedius can be depicted reliably with MRI, which might be helpful, especially in the diagnosis of the source of tumors in this region.

GENICULATE NEURALGIA AND ITS SURGICAL TREATMENT

Although nervus intermedius (geniculate) neuralgia is rare and difficult to diagnose, a number of different surgical treatment options have evolved, leading to more confusion about the most appropriate approach. The International Headache Society (10) defines nervus intermedius neuralgia as intermittent episodes of pain located deep in the ear that last for seconds or minutes; the posterior wall of the auditory canal may be a trigger zone. The pain can be accompanied by disorders of lacrimation, salivation, and taste (10). In 1909, Clark and Taylor (9) were the first to report success in treating facial pain with resection of the geniculate ganglion. Of note, some have advocated transection of the nervus intermedius for chronic cluster headaches (15, 22). In fact, Rowed (22) reported a 75% success rate using this technique in such patients. Parenthetically, this investigator found that hearing impairment was the most frequent serious complication after sectioning of the nervus intermedius (22).

Sachs (24) followed up four patients after section of the nervus intermedius,

two of them for more than 10 years. The first patient, a 43-year-old woman, suffered from attacks of right-sided face and head pain for 7 years that later became associated with severe pain in the right ear. During surgery and under local anesthesia, the facial, vestibulocochlear, and glossopharyngeal nerves, including the nervus intermedius, were explored; stimulation of the nervus intermedius resulted in pain in the ear and right face. The same symptoms could be produced when stimulating the vestibulocochlear nerve. The facial (inadvertently) and vestibulocochlear nerves and the nervus intermedius were sectioned. No recurrence was noted at 15 years of follow up. The second patient, a 56-year-old man with attacks of left-sided facial pain that were associated with ipsilateral lacrimation and nasal congestion, underwent left greater petrosal neurectomy, which brought relief for 3 years. A third patient, a 65-year-old man who suffered from attacks of pain on the left side of the face without lacrimation, nasal congestion, or ear pain, also underwent sectioning of the nervus intermedius. Lacrimation was lost, but no loss of taste occurred, and the patient became pain-free postoperatively. The fourth patient, a 36-year-old man, complained of daily headaches for 6 to 8 weeks per year. The pain was in the right cheek, eye, forehead, temple, and behind the right ear. In this case, a large internal auditory artery was seen between the facial and vestibulocochlear nerves. Sectioning of the nervus intermedius caused decrease of lacrimation and loss of taste on the anterior two-thirds of the tongue and immediate relief of pain (24). There is some variation in the distribution of pain among the above patients (some suffering from facial pain) making it difficult to assess who reliably harbored geniculate neuralgia.

Lovely and Janetta (13) reported 14 cases of patients with the primary complaint of deep inner ear pain, often in combination with atypical facial pain or throat pain. Vascular compression of the trigeminal, glossopharyngeal, or vagus nerve or the nervus intermedius was observed in almost every case and was assumed to be a cause of the primary or secondary complaints in these patients (Figures 2 and 3A).

These cases emphasize the importance of the nervus intermedius in otalgia. Four

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