Petrous Ridge Compression and its Surgical Correction

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In 1934 Dandy stated that "whatever the cause of trigeminal neuralgia might be, it must be located in the sensory root." This statement was based on his experiences in finding tumors, aneurisms, or angiomomas of the sensory root in 23 of 215 cases of typical tic, and in finding other "organic" causes in 96 patients, such as an artery or a petrosal vein in contact with the root. In 1947 when Gonzalez-Revilla reviewed Dandy's material he found that 16 of the 160 cases of angle neurinomas, five of the 13 angle meningiomas, and 10 of the 13 cholesteatomas had had the typical pain of tic douloureux. Gonzalez-Revilla, using the suboccipital approach for retrogasserian neurectomy, reported in 1962 that he found "changes of a vascular nature" in 40% of tumors of the angle in 5.1% platybasia in 2.8%, and multiple sclerosis in 0.5%.

Stookey and Ransohoff indicated that a sensory deficit was the most common finding in such cases. Certainly the presence of sensory defects not due to treatment of the trigeminal neuralgia, as by alcohol block, should suggest neoplasm, aneurism, or angiomoma.

Nevertheless, there are many cases of absolutely typical tic with no sensory or other deficit produced by demonstrable organic lesions; the cholesteatomas are particularly noteworthy examples. Gardner suggested that this may be because of their extremely slow growth. Moreover, cholesteatomas rarely destroy nerve function but rather displace and surround the nerve roots. Taarnhøj's case of cholesteatoma led to his suggestion in 1952 that compression of the posterior root was the etiological factor in tic. He had made the clinical diagnosis of probable cholesteatoma on his patient, a man of 31 years with an otherwise typical tic. He based his diagnosis on Olivecrona's report of the syndrome of cholesteatoma of the angle causing typical third-division tic in young adults.

The concept of compression at the dural foramen over the petrous tip had been advanced in 1937 by Lee, who suggested that decompression might someday be performed by removal of the bony rim of the petrous pyramid. Olivecrona later suggested that the anatomical angulation at this point, which increases with age, might be etiologic in trigeminal neuralgia. Taarnhøj performed his first decompression of the posterior root for tic douloureux on May 9, 1951. In 1954 he reported a group of 76 patients he had treated by this technique, 70 of whom had tic. He used a subtemporal intradural approach. He incised the dura over the cavum and carried the incision back through the petrosal sinus, then posteriorly "for some centimeters," then medially through the free edge of the tentorium. He operated on five patients through a posterior fossa approach, of which more will be said later. Seventeen of his patients had had some hypesthesia preoperatively. None of these had normal sensation postoperatively. Within the first year postoperatively, seven of the patients experienced a return of pain; four of these were of sufficient severity to require reoperation.

Love had learned of Taarnhøj's operation from Norlén and decided to carry out the decompression by the extradural approach using the same technique as for root section up to the exposure of the dura propria. The dura propria was left closed, however. The temporal dura was then incised, exposing a small portion of the undersurface of the temporal lobe and superior surface of the tentorium. The "dense, tense, constrictive fibers overlying the posterior root" were then divided. Of the 39 patients originally reported in 1954 by Love, 10 had not been relieved after a follow-up period of 1 to 13 months; but of these 10, only 3 were considered to have had true tic douloureux.

Gardner and Pinto reported their first nine cases of decompression in 1953. They carried out their first operation using Taarnhøj's intradural approach but subsequently they used the extradural Frazier approach advocated by Love. They then suggested the idea of an artificial synapse in the sensory root fibers where the nerve crosses the petrous apex. They suggested that a tactile stimulus is carried via the somatic afferents to the brain.
stem where it forms a reflex connection with autonomic cells, resulting in an efferent impulse which travels in the autonomic fibers accompanying the sensory root. On reaching the artificial synapse at the point of compression, the impulse is short-circuited into the pain fiber and is reflected back into the brain stem as a painful impulse. Gardner\textsuperscript{46} further suggested that the demyelination of aging plus platybasic change contributed to the compression and the short-circuiting. He performed 20 operations over a period of 5 months, all successful, but pointed out that the operation had not yet stood the test of time.\textsuperscript{68}

Gardner, \textit{et al.},\textsuperscript{57} made a special x-ray study of 130 patients with trigeminal neuralgia and concluded that tic was three times more common on the side of the higher petrous ridge. They suggested that postmenopausal osteoporosis with resulting basilar impression probably explained why trigeminal neuralgia is more common on the right side and in elderly women.

Bjerrum and Thornval\textsuperscript{9} found that their x-ray evidence essentially agreed; in 26 cases of right-sided tic, 17 had a higher right petrous ridge, six had a higher left petrous ridge, while three had ridges of equal height. In 21 cases of left-sided tic, 11 had a higher left petrous ridge, while only four had a higher right petrous and six were equal.

Svien and Love\textsuperscript{160} reviewed the results of their operations on 91 patients during a 6-year period. Sixty-nine patients had recurrences and only 22 patients remained pain-free. Fifty-five of the 69 recurrences occurred within 18 months after surgery. Of the 91 patients, there was no postoperative sensory loss in 65, and 55 of these 65 had recurrence (85.6\%). Of 15 patients who had subjective postoperative sensory loss, 10 had recurrent pain (66.7\%). Of 11 patients who had objective sensory loss, four had recurrent pain (36.4\%). Svien and Love then stated that “worthwhile results are obtained by this procedure only if the root is systematically traumatized.”

Gardner and Miklos\textsuperscript{58} analyzed 200 decompressions followed for 3 to 6 years, and found that 62\% had immediate, complete, and lasting relief from their pain. The incidence of sensory impairment was no higher in the patients with lasting relief than in those with recurrences.

Shelden, \textit{et al.},\textsuperscript{146} working independently of Taarnhøj, treated 10 patients successfully by decompressive enlargement of the foramen ovale or rotundum followed by neurolysis with saline and multiple incisions on the sheath. After comparing their results with Taarnhøj’s, they suggested that the only feature common to both was operative trauma. Accordingly, in 1953, they devised a procedure in which they compressed the posterior root fibers but did not decompress. Their report covered 29 patients so treated during the preceding year; all obtained relief from pain. Most had a subjective sensory defect of minimal degree, which cleared.

Graf\textsuperscript{62} reviewed the results of the “compression” procedure in the first 100 cases from the University of Buffalo Medical School. Four were initially unrelieved; 24\% had a recurrence of pain by 1963; this was compared with a recurrence rate of 7.8\% for compressions in 70 of the same patients reported by Hamby in 1959.\textsuperscript{68} Some 76\% of Graf’s group had persistent postoperative sensory disturbances.

Gardner\textsuperscript{44} emphasized the etiological relationship between hemifacial spasm and trigeminal neuralgia and the role of neurolysis in relieving the “artificial synapse.” Gardner also stressed the idea of a parasympathetic outflow which Lewy, \textit{et al.},\textsuperscript{112} had shown innervated the erectile tissue of the vibrissae in the cat. Gardner restated his theory that “trigeminal neuralgia is the result of a retained phylogenetic reflex in which the efferent (parasympathetic) barrage, evoked by tactile stimulus, excites the pain fiber because of an artificial synapse produced by pressure on the nerve root.”

Gardner demonstrated his technique to us in 1961, and we then used it in four operations. Later we modified the procedure so as to manipulate the nerve as little as possible; in short, we tried to accomplish clean-cut decompression at the petrous ridge with the minimum of associated compression.

We found a constant band of fibers crossing the posterior root at the petrous apex. These fibers curved outward, downward, and backward from the anterior clinoid and were attached to the anterior surface of the petrous ridge lateral to its apex. They were separated from the fibers of the temporal dura and from the dura propria. After carrying out the usual Frazier extradural approach through section of the middle meningeal artery, we established a plane of cleavage between the dura