SELECTIVE PARTIAL NEURECTOMY IN HEMIFACIAL SPASM AND THE ELECTROPHYSIOLOGIC SELECTION OF PATIENTS*

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We are concerned here with the existence of hemifacial spasm as an apparent neurological or psychoneurological disturbance characterized by paroxysmal twitching of all, or part, of the musculature of the face. A review of the extensive literature on this subject has been presented by the authors in another publication, and reveals a wide divergence of opinion regarding the etiology, classification, and treatment of the facial dyskinesias. Considering these discrepancies it seems strange that clinicians have not made more effective use of the aid proffered by electrophysiologic technics.

This discussion deals briefly with the assistance gained by the use of such technics and their practical applications.

Utilizing combined clinical and electrophysiologic observation, the hemifacial spasm occurring as an isolated neurological or psychoneurological entity can be classified as follows: (a) Spasm caused by cortical irritation. (b) Spasm resulting from involvement of the facial nucleus itself. (c) Spasm representing a psychogenic conversion reaction (habit spasm).

Hemifacial spasms occurring as an accessory symptom in a variety of neurological disorders (purulent meningitis, trigeminal neuralgia and tetanus, encephalitis, aneurysms of the basilar artery, cerebellopontine tumors, and following irritation of mes- and diencephalic areas in animals) are not a topic of this discussion.

Hemifacial spasms caused by cortical irritation are somewhat uncommon since additional neurologic signs and symptoms resulting from involvement of adjacent cortical areas are usually present. In these cases actual disturbance of the cerebral neuronal rhythmicity is noted in electroencephalographic studies.

The cases of prime interest to the neurological surgeon, however, are those in which the spasms are caused by involvement of the facial nucleus itself, which Wartenberg and others believe to be the site of lesion in this condition. Wartenberg classifies hemifacial spasm caused by nuclear firing as (1) cryptogenic facial spasm resulting from infectious or degenerative changes, or from an inferior Anlage; (2) réaction à distance in lesions of the peripheral branches of the facial nerve; and (3) postparalytic facial spasm following

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Bell's palsy. It is this type of hemifacial spasm, i.e., caused by nuclear firing, which can, and necessarily must, be differentiated from the psychogenic variety of habit spasm if neurosurgical measures are to be considered.

Unlike Thiébaut et al.\textsuperscript{16} we have been unable to differentiate these various subtypes of firing electrophysiologically. It seems that there may be a common electrophysiological basis for the hemifacial spasm caused by nuclear firing. While these three subclassifications show no definite electroencephalographic disturbance of cerebral rhythmicity, all show an electromyographic

\begin{figure}
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\includegraphics[width=\textwidth]{fig1.png}
\caption{Hemifacial spasm caused by "nuclear firing." Maximal mono- and biphasic spike bursts over left zygomatic muscle (in spite of clinical accentuation of spasms over left orbicularis oculi muscle). (A) Utilizing cup electrodes. (B) Utilizing coaxial needles (see text).}
\end{figure}
pattern of characteristic type. It was interesting to note that mono- and bi-
phasic spike bursts firing in unison over the facial muscles showed maximal
gain (200 μV) over the zygomatic muscle, while the visually apparent maxi-
mum twitching occurred in the left orbicularis oculi muscle. Occasionally
single spike forms were noted firing in repetitive fashion. A polyphasic spike
form was noted when recordings were made with coaxial needles placed in
the zygomatic muscle. The characteristic electromyogram as seen in nuclear
firing is presented in Fig. 1, demonstrating the typical fasciculation poten-
tials recorded by a sensitive ink-writer apparatus. For adequate recording
of the very much faster fibrillations which were observed by us and others,7
particularly in the post-paralytic type, a single or preferably double-beam
cathode-ray oscilloscope will have to be used.

This type of “nuclear” hemifacial spasm must be strictly differentiated
from the psychogenic “habit” spasm which occurred much more frequently
in our series of patients and which is characterized electrophysiologically by
typical “contraction-bursts,” lasting from 300–500 msec. (Fig. 2), and show-
ing 5–7.5 rapid muscle spindles/100 msec.

Having used an electrophysiological approach first to determine if the
hemifacial spasm is caused by (a) cortical irritation, (b) involvement of the
nucleus itself, or is (c) actually a psychogenic conversion reaction (habit
spasm), the problem of adequate therapy comes to mind.

![EEG (cup electrodes)](image)

![EMG (needle electrodes)](image)

**Fig. 2.** Psychogenic “habit” spasm. Rapid contraction bursts over all left facial electrode
derivations, each burst showing 5–7.5 muscle spindles/100 msec. (see text).
PARTIAL NEURECTOMY IN HEMIFACIAL SPASM

It is important, of course, that conversion reaction or spasm from cortical irritation be eliminated from any surgical consideration involving the 7th nerve. The obvious attack must be made upon this structure when the spasm is caused by nuclear involvement. Without destruction of all or part of the facial nerve, no relief of the hemifacial spasm is obtainable. Wartenberg's stated that only when the facial nerve is eliminated is the patient free of spasm. Numerous attempts have been made to relieve the patient, attempts ranging from freezing, Novocain, and/or alcohol injection, neurolysis, decompression and neurolysis, to stretching of the facial nerve. Section with immediate resuture of the nerve was also recommended by Coleman, as was changing the innervation of the involved muscles and anastomosing the facial nerve with another motor cranial nerve. The nerve-anastomoses reported included a facial-accessory anastomosis by Kennedy and a facial-hypoglossal anastomosis by Gibson. Simultaneous section of the cervical sympathetic chain to produce a Horner's syndrome with droop of the upper lid and some recession of the eye, with a narrowing of the palpebral fissure, has also been recommended. However, in the presence of a bilateral hemifacial spasm the use of some of the other motor-cranial nerves would interfere seriously with eating and drinking.

German proposed the isolation of several primary branches which, upon stimulation, caused contraction of those muscles particularly involved in the facial spasm. He recommended a small nerve flap composed of three-quarters or more of each of the involved branches, the free proximal segment to be held loosely in a reverse direction by a lightly tied suture. In 1946 Greenwood proposed (in addition to the alcohol block of the nerve) an operative technic which sections the zygomatic branch completely as well as the lowest (cervical) branch, after repeated testing of the entire nerve by electrostimulation. When the facial nerve was separated into only two divisions, a partial division was done. By first dividing the nerve longitudinally with the point of a scalpel, an anterior section followed, much in the fashion recommended by German, though the suture was felt to be unnecessary.

The procedure presented here differs from the others only in that it is a more selective partial neurectomy of the facial nerve. The principal fibers sectioned are those that are efferent to the predominantly affected muscles. Selection of these muscles is, of course, done by the previously mentioned electrophysiological technic, since the site of greatest clinical disturbance does not always correspond with the site of maximal electromyographic disturbance. Having determined which muscle group plays the greatest part in the production of the clinical picture, it is important that the greatest number of fibers to this particular zone be carefully divided, while others to less involved zones are more appropriately spared.

TECHNIC OF OPERATION

Under Pentothal anesthesia, with an intratracheal tube in place, the patient is prepared and draped for a preauricular operation. The drapes are so arranged that they may be elevated in order to observe the patient while stimulation studies are
being conducted. A curvilinear incision is made bordering on and paralleling the tragus of the ear, swinging below it and down the neck for a short distance (Fig. 3). The skin flap is then reflected forward, exposing the parotid gland. With stimulation studies the approximate location of the nerve within the gland is made and the gland is incised, usually near its anterior edge. The section is carefully carried down to the trunk of the facial nerve which is then exposed in its major divisions. Care must be taken to avoid damage to the parotid duct. When the facial nerve and its primary divisions have been isolated, attention is then directed to those branches supplying the area most severely involved.

Before any procedure is carried out on these branches, however, the entire facial nerve is stimulated, using a current of 2 to 3 volts of 60-cycle alternating current, usually of a single stimulus type. In keeping with Greenwood’s1 statement, the key to successful operation is the ability to locate the nerve and its branches, using electrical currents, and to gage the amount of weakness produced in the various muscle groups so that a noticeable paralysis is not produced. It is important that the orbicularis oculi be left with enough strength to close the eye and still eliminate most, if not all, of the twitching.

Having determined the amount of current necessary to stimulate the entire face on the affected side, the surgical attack on the individual divisions is made. Using the stimulating electrode to locate the branch leading to that muscle most seriously incriminated by the electromyogram, the individual nerve fibers are then teased free of the epineurium, using the dissecting needles (Fig. 4). After one such fiber is isolated over the needle point, the stimulator is applied. If the end-response to this stimulation is properly located with reference to the electromyogram, the fiber is then divided. The entire branch is then picked up and stimulated. Another isolated fiber is picked up, stimulated and divided. This procedure is continued until enough fibers have been sectioned in a specific nerve division so that only a limited response

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Fig. 3. Placement of incision for selective partial neurectomy.
in the innervated musculature results. Care should be taken to stimulate the entire nerve on completing this differential section, to determine the over-all response. Using the same current that was used to stimulate the nerve at the beginning of the operation, a considerably weaker response should be elicited. This procedure is followed down through the various divisions, different numbers of fibers being sectioned in each, consistent with the electromyographic response determined previously. Upon completion of this partial neurectomy in the involved divisions, the total nerve is again stimulated to note the over-all effect. Usually no further section is necessary at this point. The parotid gland is then resutured and the incision is closed in the usual manner, a pressure dressing being applied.

Upon awakening, the patient usually shows some weakness when smiling, though the resting face appears normal. While blinking of the eye is possible, it is somewhat sluggish. It is notable that after the 3rd or 4th day, postoperatively, an additional degree of paresis of the face occurs frequently, then subsequently begins to clear. When healing is completed, in the final evaluation of the procedure there is no evidence of paresis of the resting face, though upon smiling broadly slight weakness is apparent. Blinking motions of the eye are very nearly normal. It must be stated that occasional flicker-like spasms are still detectable, especially in oblique light, which are not at all disturbing to the patient.

Of particular interest here is the fact that most of the fibers to the more seriously affected part are divided, wherein this particular form of partial facial neurectomy differs from those previously employed. It is believed that
this more selective type of partial neurectomy is more satisfactory, not only from the functional, but from the aesthetic standpoint as well.

CONCLUSIONS

(1) Using electrophysiologic technics it is possible to isolate those cases of hemifacial spasm caused by involvement of the facial nucleus, or nerve radix, from those resulting from cortical irritation, or representing a psychogenic conversion reaction.

(2) At present the only successful approach for relieving the patient with hemifacial spasm caused by “nuclear and/or radicular firing” is a direct attack of varying degree upon the facial nerve itself, i.e., the executor of the spasm.

(3) The selective partial neurectomy wherein the fibers efferent to the site of maximum electromyographic disturbance are sectioned appears to be a more satisfactory approach to this particular surgical problem from both a functional and an aesthetic viewpoint.

REFERENCES