Treatment of spasmodic torticollis with intradural selective rhizotomies

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To determine the effects of ventral cervical and selective spinal accessory nerve rhizotomy on spasmodic torticollis, 58 patients who had undergone surgery between 1979 and 1987 were reviewed retrospectively. At the time of surgery, each nerve rootlet was electrically stimulated to determine its effect on the nuchal musculature prior to sectioning. Forty-nine patients (85%) had a marked improvement in their condition, with 33 (57%) attaining an excellent result and 16 (28%) noting significant improvement. Patients complained of abnormal head posture, nuchal muscle spasms, and pain prior to surgery. Muscle spasms were completely relieved in 42 patients (72%) and markedly reduced in 10 (17%). Of the 47 patients with preoperative pain, 30 (64%) were free of their pain and eight (17%) noted that the pain was reduced in intensity and frequency. Thirty-four patients (59%) reported that their resting head posture was restored to a neutral position. The likelihood that a patient's head posture returned to normal was inversely proportional to the preoperative duration of the spasmodic torticollis. Twenty-six patients (45%) suffered mild transient difficulty with swallowing solid foods in the immediate postoperative period. In most cases these minor difficulties abated in the months following surgery.

KEY WORDS • spasmodic torticollis • rhizotomy • spinal accessory nerve

SPASMODIC torticollis, characterized by involuntary tonic or clonic muscle movements of the neck, has puzzled physicians for centuries. The term "torticollis" is said to have been coined by Rabelais, a 16th century French Benedictine, and a vivid description of people afflicted with this disease is contained in Dante's Inferno, written in the 13th century. Over 50 years ago, Finney and Hughson13 lamented, “Today we are apparently as far from knowing the real cause of torticollis as were surgeons one hundred years ago.” In recent years, spasmodic torticollis has been classified as a focal dystonia, but its specific pathophysiology remains obscure.12

Reflecting the variety of hypotheses proposed to explain this condition, several forms of therapy have been offered. Most surgical procedures have attempted to interrupt the motor pathway responsible for head turning. The earliest surgical attempt at preventing the involuntary tonic or clonic neck movements involved sectioning various portions of the nuchal musculature. In 1834, Bujański was the first to report treating spasmodic torticollis by ligation of the spinal accessory nerve.52 Although today some surgeons employ stereotactic lesions of the basal ganglia and others are investigating treatment by microvascular decompression of the spinal accessory nerve, most patients are treated by cervical neurectomy or rhizotomy.

In this report, we survey our experience treating spasmodic torticollis with ventral cervical and selective spinal accessory nerve rhizotomy and review other forms of therapy. In our surgical approach, emphasis is placed on intraoperative electrical nerve root stimulation. This critical review demonstrates the strengths and pitfalls of our technique.

Clinical Material and Methods

Patient Population

Fifty-eight patients underwent intraspinal rhizotomy for the treatment of spasmodic torticollis between 1979 and 1987. There were 14 men and 44 women ranging in age from 22 to 71 years. Thirty-two patients had predominantly rotational torticollis with the occiput turning to the right and 23 with the occiput turning to the left; most of these patients had a lesser element of laterocollis, with the head being tilted in the direction of the occiput. Three patients presented with pure retrocollis.
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Symptomatology

Most patients in this series did not have a recognized prodrome prior to the onset of torticollis. Three patients reported having an upper respiratory tract infection in the month prior to the onset, and two patients were involved in motor-vehicle accidents in the weeks prior to the onset of their head-turning. The onset of the torticollis was never abrupt. Patients most often complained of a "crick in the neck," neck muscle tightness, or "a pulling sensation in the neck" which evolved into clinically apparent torticollis. Initially the head-turning was intermittent but, as the disease progressed, the head-turning became constant and abated only with sleep. Most patients could momentarily return their heads to a neutral position with great effort and reported that their heads would easily assume a more normal position by simply placing a finger on the chin. They also noted that head rotation would worsen with emotional stress.

The patients suffered with torticollis for a period of 9 months to 20 years prior to surgery. Because of our brief preoperative encounter with these patients, we were unable to assess the progression of our patients' torticollis objectively. By their own accounts, approximately 50% of the patients had torticollis that was still evolving and worsening at the time of surgery. The remainder reported that their symptoms had plateaued 4 months to 5 years after onset. Only one patient reported a significant spontaneous remission, which occurred 5 months after onset; her rotational torticollis returned 8 months later and persisted for the next 4 years prior to surgery.

Preoperatively, patients complained of abnormal head position, muscle spasms, and pain. Head rotation was intermittent at the onset of spasmodic torticollis but, at the time of surgery, 47 patients reported that it was constant except during sleep. Pain was a significant problem in 47 of the 58 patients. The pain was described as most intense over the lateral neck or in the posterior cervical and suboccipital area, with radiation to the shoulder. The aching pain was exacerbated by fatigue and was most severe at the end of the day. In quality and distribution, the pain was reminiscent of that associated with cervical spondylosis.

Only three patients had a movement disorder outside of the cervical musculature. One patient suffered a concomitant facial tic, one a benign essential tremor, and one a tardive dyskinesia. No patient reported a family history of dystonia.

Previous Therapy

Prior to surgery, all patients were given a trial of other forms of therapy. Medications administered varied from patient to patient and included anticholinergic agents, \( \gamma \)-aminobutyric acid (GABA) enhancing agents, anticonvulsant medications, muscle relaxing agents, and pain medication. Rarely did any of these agents significantly affect the spasmodic torticollis. Most patients had a preoperative trial of biofeedback and transcutaneous nerve stimulation. A few patients were treated with acupuncture. Three patients had undergone a unilateral peripheral spinal accessory nerve section that failed to cure rotational torticollis, and one patient had undergone an unsuccessful stereotactic ventrolateral thalamotomy.

Electromyography

Preoperative electromyography (EMG) demonstrated varying evidence of involuntary suprasegmental hyperactivity, with the most common being bursts of suprasegmental electrical activity. In some cases this spontaneous activity was recorded only from a single sternocleidomastoid muscle but, in many cases, this synchronous spontaneous activity was recorded in the paraspinal muscles and even the contralateral sternocleidomastoid muscle. Although the patients could temporarily inhibit spontaneous muscle contractions, spontaneous electrical activity would soon break through. In patients without torticollis, the two sternocleidomastoid muscles normally demonstrate reciprocal inhibition. When the head is rotated, the sternocleidomastoid muscle contralateral to the chin rotation becomes active while the sternocleidomastoid muscle ipsilateral to the rotated chin becomes virtually electrically silent. The patients with rotary torticollis demonstrated impaired reciprocal inhibition, especially when rotating their chins toward the most affected sternocleidomastoid muscle. Instead of becoming electrically silent, this muscle maintained a high level of spontaneous electrical activity. Complex motor units or other electrical signs of muscle denervation were rarely demonstrated.

Radiology and Swallowing Studies

Cervical spine roentgenograms were obtained for each patient to rule out rotary subluxation or any other structural cause of nonspasmodic torticollis. The degree of spondylotic change seen on these roentgenograms was striking and appeared to be more than expected for the patients' age. Myelography was performed in a limited number of patients and frequently demonstrated cervical spondylotic ridges with concomitant nerve root compression. Seven of our patients had undergone prior operations on their cervical spine for radiculopathies related to spondylitis. In order to face forward, patients suffering from spasmodic torticollis compensate for the abnormal head posture by rotating and tilting their shoulders. Routine chest roentgenograms reflected this compensatory posture by demonstrating scoliotic and kyphotic curves of the thoracic spine.

Prior to surgery, swallowing was examined by fluoroscopy in 33 patients, and approximately 65% of these patients were found to have some abnormality in the pharyngeal phase. Mild aberrations included lateralization of the pharyngeal transient which was probably a function of the patients' abnormal postures and delayed swallowing reflexes. Severe abnormalities included frank aspiration. Four additional patients who did not undergo preoperative fluoroscopic swallowing studies complained of subjective difficulty with swallowing.

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serve any radicular artery that accompanies the rootlets. The upper cervical nerve rootlets are found to innervate the posterior paraspinous muscles but not the trapezius or sternocleidomastoid muscle. Special efforts are directed toward dividing the anastomotic branches between the C-1 rootlets and the spinal accessory nerve. Unlike the spinal rootlets, these anastomotic nerves are frequently found to cause strong sternocleidomastoid muscle contraction when stimulated.

McKenzie\(^3\) reported a nerve rootlet originating rostral to the vertebral artery and descending and exiting with the C-1 ventral root (Fig. 1). McKenzie thought that this nerve rootlet was present in 50% of patients and that failure to section the rootlet resulted in an incomplete clinical effect on the sternocleidomastoid muscle. We believe that the McKenzie rootlet is more rare, being noted only twice in our group of 58 patients. Reference to this nerve rootlet could not be found in a review of several current textbooks of anatomy.

The spinal accessory nerve courses parallel to the cervical spinal cord, ventral to the dorsal roots, and dorsal to the dentate ligament. It passes over the vertebral artery and exits through the jugular foramen (Fig. 1). Stimulation of the rootlets forming the spinal accessory nerve gives a variable response. Some of these rootlets innervate the sternocleidomastoid muscle, some the trapezius muscle, and some appear to innervate the paratracheal musculature. Only those rootlets of the spinal accessory nerve that are found to innervate the sternocleidomastoid muscle are divided.

In most previously described operations for spasmodic torticollis, the spinal accessory nerve was sectioned at the level of the foramen magnum, leading to paralysis of the trapezius muscle and incomplete denervation of the sternocleidomastoid muscle. The trapezius muscle is usually not involved in spasmodic torticollis. In our method, rootlets of the spinal accessory nerve were selectively sectioned bilaterally.

In certain cases, variations of the outlined procedure were performed. Five patients with rotary torticollis underwent ventral rhizotomies without concomitant selective spinal accessory nerve rhizotomies. The three patients with pure retrocollis also underwent ventral cervical rhizotomies. Only seven patients had unilateral C-4 ventral rhizotomies and eight patients had bilateral C-4 rhizotomies in addition to the above outlined procedure. Stimulation of each of the C-4 ventral rootlets in some patients resulted in contraction of the diaphragm; in other patients only the lower C-4 ventral rootlets were found to innervate the diaphragm.

Results

Follow-Up Study

All patients included in this report have been followed for at least 1 year postoperatively. Each patient was examined during the postoperative period by the operating surgeon and subsequently questioned via telephone conversation with a member of our department who had not participated in the patient’s operation. Five additional patients who could not be contacted were not included in this study.
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![Fig. 2. Drawings derived from photographs of patients with spasmodic torticollis before and after undergoing intradural motor rhizotomy. Note the variations in head posture and postoperative improvement. The following conditions are depicted: pure rotational torticollis (A); pure laterocollis (B); pure retrocollis (C); rotational and retrocollis (D); rotational and laterocollis (E); and rotational and laterocollis (F).](image)

The results of surgery were evaluated by the patient's subjective assessment, residual muscle spasms, abnormal head posture, pain, and untoward effects of operation. Patients were considered to have an excellent result if they were subjectively rid of torticollis, free of spontaneous muscle spasms, suffered no or minimum pain, had normal or almost normal head position, and had no untoward effects from surgery (Fig. 2). Patients were considered to have a fair result if they no longer had spasmodic muscle contractions but were still in pain or had a significantly abnormal neck posture at rest. Patients with persistent nuchal muscle spasms, severe neck pain, worsening of nuchal posture, or a persistent untoward effect from surgery were considered to have a poor result.

Using these criteria, 33 patients (57%) were considered to have attained an excellent result, 16 (28%) a fair result, and nine (15%) a poor result (Table 1). All patients who were afforded an excellent result at 6 months postoperatively remained in this category for the duration of the study. Forty-two patients (72%) stated that they were completely free of involuntary muscle contraction and 10 (17%) noted that the involuntary contractions occurred only occasionally (Table 2). The remaining six patients reported some persistent spontaneous nuchal muscle contraction. Thirty (64%) of the 47 patients with preoperative symptoms were pain-free, eight (17%) noted that the pain was reduced in intensity and frequency, and nine (19%) reported

### Table 1

Results of selective rhizotomy in 58 patients with spasmodic torticollis

<table>
<thead>
<tr>
<th>Result*</th>
<th>Cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>excellent</td>
<td>33 (57%)</td>
</tr>
<tr>
<td>fair</td>
<td>16 (28%)</td>
</tr>
<tr>
<td>poor</td>
<td>9 (16%)</td>
</tr>
<tr>
<td>total</td>
<td>58</td>
</tr>
</tbody>
</table>

* For a definition of each result, see text.

### Table 2

Symptom resolution after selective rhizotomy in patients with spasmodic torticollis

<table>
<thead>
<tr>
<th>Symptom</th>
<th>No. of Cases</th>
<th>Result*</th>
</tr>
</thead>
<tbody>
<tr>
<td>spontaneous muscle spasm</td>
<td>58</td>
<td>Excellent 72%</td>
</tr>
<tr>
<td>pain</td>
<td>47</td>
<td>Excellent 64%</td>
</tr>
<tr>
<td>resting head position</td>
<td>58</td>
<td>Excellent 59%</td>
</tr>
</tbody>
</table>

* For a definition of each result, see text.
some persistent pain. Thirty-four patients (59%) reported that their heads returned to a neutral position while they were at rest and an additional nine noted a marked improvement in the resting posture of their heads. Twenty-five of the 34 patients with a disease duration of less than 5 years preoperatively noted that their heads returned to a neutral position at rest, but only 10 of 24 patients with spasmodic torticollis for more than 5 years reported a neutral head position while at rest (p < 0.04) (Table 3). In one patient with long-term torticollis and a compensatory thoracic scoliosis, the procedure actually resulted in a worsening of the patient's resting head position due to a loss of muscle tone. Although the procedure severely denervates the sternocleidomastoid muscles, most patients regained 30° to 45° of lateral head rotation. Voluntary contraction of the sternocleidomastoid muscle partially returned in the months following surgery, but the unwanted involuntary contractions of spasmodic torticollis did not.

Five patients with rotary torticollis were treated by ventral cervical rhizotomies without spinal accessory nerve section. One subsequently underwent a peripheral selective spinal accessory nerve section and was afforded a fair result. One of the four remaining patients treated by ventral cervical rhizotomies alone had a fair result but the other three had poor results. All three patients with retrocollis had good relief of their symptoms and their results were rated as excellent.

**Complications**

Minor difficulties with swallowing were common in the immediate postoperative period. No patient reported difficulty with swallowing liquids, but 28 noted that solid foods would “stick in my throat.” Many of these patients observed that it was easier to swallow solid food by following the mastication of dry foods with a sip of water while holding the head erect. This difficulty with swallowing completely resolved at an average of 4 months postoperatively. Some subjective postoperative swallowing abnormality was noted in 33% of the patients who had intraoperative EMG monitoring and in 46% of those who did not (not significantly different). Thirty-four patients underwent a fluoroscopic examination of their swallowing in the week following surgery. Symptomatic patients had a slight delay in pharyngeal swallowing reflexes triggered at the level of the vallecula after the first swallow of solid food; these patients had residual material in their pharynx which cleared during subsequent swallows. This finding indicates a decrease in pharyngeal peristalsis. In the most impaired cases a pulsion diverticulum indicating pharyngeal weakness was demonstrated. In three patients contrast material demonstrated entering the laryngeal vestibule, but there was no penetration of the weak cords and no demonstrable aspiration. Frank aspiration was seen in three patients, with only one developing an aspiration pneumonia. In the small number of patients who underwent a second swallowing study in the months following their surgery, swallowing reflexes and pharyngeal peristalsis were improved.

Although swallowing difficulties were common, con-

<table>
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<tr>
<th>Duration of Disease</th>
<th>No. of Cases</th>
<th>Resting Head Position</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 5 yrs</td>
<td>34</td>
<td>74%</td>
</tr>
<tr>
<td>&gt; 5 yrs</td>
<td>24</td>
<td>42%</td>
</tr>
</tbody>
</table>

comitant respiratory difficulties were rare. A total of 22 C-4 rhizotomies were performed on 13 patients. Six hemidiaphragms demonstrated paradoxical movement on postoperative fluoroscopy. One patient developed intermittent difficulty with inspiration postoperatively which resolved following correction of a congenital abnormality of the epiglottis. A second patient with severe thoracic scoliosis and chronic bronchitis developed respiratory distress on the day following surgery, which resolved with medical therapy.

One patient developed a postoperative worsening of cervical kyphosis which did not require surgical intervention. Two patients had cerebrospinal fluid leaks through the operative site; both were treated with local wound care and neither required wound revision. Two elderly patients died during the postoperative period, one of complications following an intraoperative myocardial infarction and the second of aspiration pneumonia secondary to impaired swallowing.

**Discussion**

The underlying pathological condition of spasmodic torticollis remains unknown. Although torticollis is presently classified as a variant of adult onset dystonia, this classification does not explain the underlying pathological process. Only one patient in our series developed additional signs of adult onset dystonia during the follow-up period. At present, it could even be argued that spasmodic torticollis is a clinical manifestation of more than one primary pathological process.

**Natural History**

Several reports have appeared in the literature charting the clinical course of patients with torticollis. Although these reports are not in complete agreement, general trends are apparent. Torticollis is mild and intermittent at its onset but progresses in severity to reach a plateau after a disease duration of 5 years. Approximately 10% of patients with torticollis will have a temporary spontaneous complete remission. Most authors note that when spontaneous remission occurs, it usually appears early in the course of the disease when head-turning is only intermittent. A second group of patients note a spontaneous diminution but not resolution of their torticollis.

**Medical Therapy**

Since torticollis has been considered a manifestation of basai ganglia disease, several classes of medicines aimed at stimulating or inhibiting specific receptors have been tried. Although reports of medication alle-
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...dystonia abound, these therapeutic triumphs are rarely corroborated by further study. The most reproducible clinical improvement has been shown to occur with anticholinergic agents. Antidepressant medications, dopamine receptor blocking agents, amantidine, and GABA enhancing regimens have all been reported to be of some benefit in treating spasmodic torticollis. Our series consists of patients who received an average of four to five administrations of these agents without demonstrating significant benefit.

Other less invasive modes of therapy have been advocated. Brudny and coworkers\textsuperscript{6,24} reported the benefit of biofeedback using a display of the patient’s EMG in treating spasmodic torticollis. After undergoing this procedure, three of nine patients maintained a normal head position indefinitely and an additional three maintained their heads in a neutral position for hours. Although 22 of our patients underwent a trial of biofeedback, none attained significant relief of symptoms. Gildenberg\textsuperscript{27} reported the results of electrical stimulation in the treatment of 29 patients with spasmodic torticollis. Three patients were afforded excellent relief of symptoms through transcutaneous nerve stimulation. Dorsal column stimulation was evaluated in 22 patients. Of 15 patients who obtained good relief with percutaneously placed temporary electrodes, four had excellent relief of spasmodic torticollis and an additional seven had relief of pain with a permanently placed dorsal column stimulator. Fahm\textsuperscript{10} noted that his patients with a range of manifestations of dystonia did not benefit from dorsal column stimulation. We have no experience with dorsal column stimulation and have not found transcutaneous stimulation to be of benefit to our patients. Intramuscular injections of botulinus toxin have been found to mitigate the symptoms of spasmodic torticollis for 2 to 3 months; however, adverse effects include dysphagia and tolerance to the drug after multiple injections.\textsuperscript{30,41}

**Surgical Options**

Myotomy, the earliest surgical procedure used to treat spasmodic torticollis, is of only historical interest and is no longer performed to treat spasmodic torticollis. Foerster\textsuperscript{44} described performing posterior cervical rhizotomy to disrupt the primary reflex loop, but this procedure has not proven effective. Surgical approaches that are presently used for the treatment of spasmodic torticollis can be divided into four different types of procedures: stereotactically placed lesions in the diencephalon, microvascular decompression, extradural neurctomy, and intradural rhizotomy. Two general stereotactic targets have been proposed for the treatment of spasmodic torticollis. Stejskal, \textit{et al.}, \textsuperscript{26} reported lesion placement in the corticocapsular adrenergic fibers adjacent to the caudate nucleus in the anterior inferior of the internal capsule. Approximately 50% of their 15 patients were relieved of symptoms for an unspecified period of time. Several authors have reported making stereotactic lesions in the ventral medial thalamus and fields of Forel.\textsuperscript{4,33} Approximately two-thirds of patients undergoing these procedures reported satisfactory results. These encouraging results are tempered by the possibility of dysarthria and dysphasia secondary to concomitant disruption of the adjacent corticobulbar fibers.\textsuperscript{4} In order to avoid this complication, Bertrand, \textit{et al.},\textsuperscript{29} proposed complementing a unilateral thalamotomy with peripheral nerve sectioning.

Because of the clinical similarities between spasmodic torticollis and hemifacial spasm, some surgeons have investigated treating spasmodic torticollis with microvascular decompression or neurolysis of the spinal accessory nerve. Freeckmann, \textit{et al.},\textsuperscript{13} reported that approximately one-third of patients enjoyed a marked improvement and another 40% sustained noticeable improvement following neurolysis of the spinal accessory nerve and limited nerve rootlet section. Other authors noted vascular compression of the spinal accessory nerve in association with spasmodic torticollis.\textsuperscript{31,36} In most reports, limited rhizotomies were necessary to unnerve the nerve from the offending vessel. Shima, \textit{et al.},\textsuperscript{36} postulated that spasmodic torticollis could be the result of multiple etiologies and that only the subset of patients whose condition worsened at rest could be helped by microvascular decompression. Jho and Jannetta\textsuperscript{22} recently reported that 14 of 20 patients who underwent microvascular decompression of the spinal accessory nerve at the brain stem were largely cured of spasmodic torticollis. Interestingly, most of their patients improved gradually over a 2-year period following surgery. The place for microvascular decompression in the treatment of spasmodic torticollis is still not defined. Since so many muscles appear to be involved in spasmodic torticollis, it is surprising that manipulation of a single spinal accessory nerve would alleviate all symptoms.

Because of the technical ease of intraspinal rhizotomies, extraspinal neurctomies are less frequently attempted. Keen,\textsuperscript{23} on the advice of Weir Mitchell, first reported treating spasmodic torticollis with unilateral extraspinal neurctomies in 1891. Finney and Hugson\textsuperscript{13} described a bilateral extraspinal neurctomy of C1–3 along with bilateral ligation of the spinal accessory nerve at the posterior border of the sternocleidomastoid muscle. Of 31 patients treated by this procedure, 12 were reported as cured and an additional 16 were markedly improved.

Bertrand, \textit{et al.},\textsuperscript{9} reported a very elegant technique of identifying those muscles involved in pathological neck rotation in a given patient. The operation was then customized to denervate the involved muscles;\textsuperscript{21,23} 88% of 91 patients treated by this method were completely relieved of their torticollis or had only slight residual head rotation or inclination.

Intraspinal surgery for the treatment of spasmodic torticollis evolved over the first half of this century. Taylor\textsuperscript{44} in 1915 described treating this condition with intraspinal posterior rhizotomies of the upper four cervical roots. McKenzie\textsuperscript{28} carried this one step further by unilaterally sectioning the spinal accessory nerve and the motor and sensory roots of the upper three cervical roots. Poppen and Martinez-Nicochet\textsuperscript{44} reported performing cervical rhizotomies and a sternocleidomastoid muscle resection for this condition. Dandy\textsuperscript{9} performed bilateral intradural motor and sensory rhizoto-
TABLE 4
Results of ventral rhizotomies for spasmodic torticollis

<table>
<thead>
<tr>
<th>Authors &amp; Year</th>
<th>Spinal Accessory Neurectomy</th>
<th>No. of Cases</th>
<th>Cases Improved</th>
</tr>
</thead>
<tbody>
<tr>
<td>Putnam, et al., 1949</td>
<td>intradural and sometimes extradural section</td>
<td>18</td>
<td>16 (89%)</td>
</tr>
<tr>
<td>McKenzie, 1955</td>
<td>peripheral denervation of sternocleidomastoid muscle</td>
<td>12</td>
<td>10 (83%)</td>
</tr>
<tr>
<td>Sorensen &amp; Hamby, 1966</td>
<td>intra- or extradural section</td>
<td>41</td>
<td>40 (98%)</td>
</tr>
<tr>
<td>Wyss &amp; Gildenberg, 1969</td>
<td>extradural section</td>
<td>26</td>
<td>22 (84%)</td>
</tr>
<tr>
<td>Tasker, 1976</td>
<td>peripheral denervation of sternocleidomastoid muscle</td>
<td>21</td>
<td>17 (81%)</td>
</tr>
<tr>
<td>Fabinyi &amp; Dutton, 1980</td>
<td>unilateral intradural section</td>
<td>20</td>
<td>18 (90%)</td>
</tr>
</tbody>
</table>

Symptoms of C1–3 and intradural division of both spinal accessory nerves. He reported complete cessation of involuntary head movements in five of eight patients and partial symptomatic relief in an additional two.

The procedure as practiced since that time generally incorporates ventral cervical rhizotomies with partial or complete spinal accessory neurectomy performed at the level of the foramen magnum. Extraspinal procedures section only the branches that innervate the sternocleidomastoid muscle. Perot reported that peripheral sectioning of sternocleidomastoid muscle innervation does not afford lasting relief of symptoms and proposed selective sectioning of the spinal accessory nerve rootlets that innervate the sternocleidomastoid muscle. A compilation of the available literature shows that more than 80% of patients improve following ventral cervical rhizotomies and some form of spinal accessory neurectomy (Table 4).

Clinical Outcome
A close review of our series demonstrated that ventral cervical root section and selective spinal accessory nerve rhizotomy were more efficient at relieving some symptoms of spasmodic torticollis than others. Although 84% of patients enjoyed a significant improvement, only 56% were alleviated of all symptoms. Spontaneous muscle contractions were noted in all but one of our patients preoperatively, and rhizotomies were relatively effective in alleviating this symptom. These contractions were completely quieted in 72% of patients and another 17% noted only occasional residual contractions. Pain is only occasionally mentioned as a symptom of spasmodic torticollis. A notable exception was recorded by Sorensen and Hamby, who reported that pain was a significant symptom in 42 of their 71 patients. In our series 47 patients had significant preoperative pain. Early in our experience, we thought that a large portion of the pain was secondary to cervical spondylosis. Surprisingly, 63% of these patients were free of their preoperative pain postoperatively and an additional 17% noted that pain was significantly reduced. Although it was assumed that the head would return to a neutral position after spontaneous muscle contraction abated, only 60% of our patients noted that their heads returned to a neutral position at rest. The chance of a patient's head turning to a neutral position was inversely proportional to the duration of that patient's disease. In this series, cervical and selective spinal accessory nerve rhizotomies were surprisingly effective in alleviating pain but were less effective in restoring normal head position.

Analysis of Complications
Dysphagia is a potential hazard of intradural spinal accessory nerve section. Dandy noted that two of his patients had minor dysphagia, most marked in swallowing solid foods. Sorensen and Hamby reported that 19 patients had postoperative dysphagia but did not comment on the extent of the problem. Although a few of our patients noted subjective improvement in the ability to swallow following surgery, approximately 50% of the patients noted some dysphagia on direct questioning. Most patients did not describe any difficulty unless specifically questioned. In most patients this abnormality was transient, with subjective and objective improvement in the months following surgery; however, aspiration contributed to the death of one patient. Because of the careful monitoring techniques employed at the time of spinal accessory nerve rhizotomies, it must be assumed that some spinal accessory nerve rootlets innervate both the sternocleidomastoid muscle and the pharynx.

Spinal instability has been a concern following denervation of the cervical musculature. Sorensen and Hamby reported that three of their patients developed cervical spinal subluxation. Tasker noted that one patient in his series developed cervical spine subluxation severe enough to cause a quadriparesis which resolved after surgical stabilization of the cervical spine. One patient in our series with a 23-year history of spasmodic torticollis and a severe compensatory thoracic scoliosis has had difficulty maintaining her head in an upright position since her surgery. Most patients in our series retain a surprisingly good ability to turn their heads. Neck weakness is rarely a complaint after the completion of postoperative physical therapy.

A few authors have reported patients with severe neurological deficits attributable to spinal cord or brainstem infarction. We did not encounter any evidence of postoperative central nervous system dysfunction in our patients.

Conclusions
Cervical rhizotomies and selective spinal accessory nerve section are good but not perfect therapy for neck spasms and pain associated with spasmodic torticollis. Patients with long-term spasmodic torticollis will probably retain some degree of head tilt or rotation when at rest. In patients with severe long-term spasmodic torticollis and compensatory thoracic scoliosis, this muscle weakening procedure may worsen the patient's resting head position. Postoperative dysphagia, especially for solid foods, is common but is usually mild and transient. Definitive treatment of spasmodic torticollis awaits a better understanding of its pathophysiology.
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References


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