MANAGEMENT OF BLEPHAROSPASM*

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INTRODUCTION

BLEPHAROSPASM IS CHARACTERIZED BY THE INSIDIOUS ONSET OF INVOLUNTARY spasms of the muscles that effect eyelid closure. It ranges in severity from only mildly bothersome to severely incapacitating. It usually is bilateral but can be asymmetric; it occurs in association with various neurologic and other disorders, and primarily affects patients in the middle to older age groups. When it occurs alone, the term "essential blepharospasm" is applied. Although the basal ganglia, central dopaminergic system, and other central nervous system structures likely are involved in the pathogenesis of this entity, its precise cause is not known. The frequent and unpredictable interruptions of vision caused by blepharospasm prevent many patients from functioning satisfactorily in their daily lives and lead them to seek medical care.[1,2]

Unfortunately, there is no consistently safe and effective treatment for blepharospasm. Medical therapies and other conservative measures have been tried but seldom have been of value in relieving the symptoms.[2] The two surgical procedures that have been used most commonly in recent years involve either extirpation of the branches of cranial nerve VII (facial nerve), that innervate the eyelids and brow (neurectomy), or excision of eyelid and brow muscles (myectomy) together with strengthening of the eyelid retractors.[3-8] Because neither procedure can be performed quickly and easily and both can lead to complications, a better treatment would be welcome.

Scott[9] recently developed a technique that involves the injection of botulinum toxin into the eyelids. The toxin interferes with the release of

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acetylcholine from nerve terminals and thereby paralyzes the muscles used in eyelid closure. Their initial results[10] and those of others[11,12] seem to indicate that, at least in the short-term, this therapy is safe and effective. Infrequently, however, ptosis or weakness of the superior rectus muscle has been observed.[10-12] Because botulinum toxin usually provides only temporary relief of symptoms, most patients have required repeat injections.

At present, it remains unclear whether neurectomy, myectomy, botulinum toxin injection, or some combination of procedures represents the optimal approach to treatment of patients who have not responded to more conservative measures. Therefore, we began this study of the clinical characteristics and results of therapy among patients who have undergone one or more of these procedures at the Mayo Clinic.

METHODS

The medical information system at the Mayo Clinic provides the resources necessary to identify patients with any specific disease, or who have had any particular operation, and to conduct follow-up studies of them. For the present study, this resource was used to locate the original medical records of all patients with blepharospasm who had undergone either neurectomy or myectomy at the Mayo Clinic between 1950 and the end of 1984. All patients who received botulinum toxin injection for treatment of blepharospasm at the Mayo Clinic between November, 1984 and April 15, 1985, also were included in this study.

Data concerning demographic characteristics, duration and severity of blepharospasm, previous therapy, and number and types of surgical procedures were abstracted from the medical records. For comparison of the various surgical approaches, each patient was categorized according to the initial operation performed at the Mayo Clinic during the period of this study. Information regarding each patient's ability to drive, read, watch television, perform household tasks, and continue with his or her usual occupation was also collected. The degree of preoperative functional impairment due to blepharospasm was determined from this information and was categorized as either mild, moderate, or marked: mild, symptoms did not interfere in any significant way with activities required for daily living; moderate, symptoms interfered with, but did not prevent, driving or performance of the usual duties of the patient's occupation; marked, symptoms were severe enough to preclude or greatly limit driving or performance of the usual duties of the patient's occupation.

To confirm the information regarding preoperative functional status and to evaluate the postoperative results, questionnaires were sent to all of the patients and to the physicians who referred them to the Mayo Clinic. Based on the responses and on the information in the medical records, postoperative functional impairment was evaluated and compared with preoperative impairment. Significant recurrent or residual blepharospasm was considered to be present when the postoperative impairment was judged to be still moderate or marked. Patient satisfaction with treatment was also assessed from the questionnaires and by reviewing the patients' statements noted in the medical records. The value of surgical treatment, as viewed by the patients, was categorized as "helpful," "of no value," or "made the situation worse."

The chi-square method was used to test for significant differences between the neurectomy and myectomy groups, with regard to previous and subsequent therapy, presence of recurrent or residual blepharospasm, patient assessment of treatment, and other characteristics. For comparisons involving small sample sizes, Fisher's exact test was applied. Kaplan-Meier[13] survival analysis methods were used to evaluate group differences in need for additional surgical procedures after the initial operation.

TREATMENTS

SURGICAL TECHNIQUES

Two different types of neurectomy operations and two different types of myectomy operations were used during the period of this study. For extirpation of branches of the facial nerve, either a proximal or a distal approach was selected, the choice depending on the surgeon. Both procedures were performed under general anesthesia. In the proximal approach, branches of the facial nerve were identified through an incision that began 2 cm anterior to the external auditory meatus, just beneath the lower border of the zygoma and extending downward for 3 to 4 cm approximately parallel to the attachment of the pinna (Fig 1A).[3] Zygomatic, temporal, and buccal branches supplying the muscles of the eyelids were identified, with the aid of a facial nerve stimulator, where they emerged from the parotid gland. Each branch was divided as proximally as possible and was avulsed as distally as possible within the wound, by curling the nerve on the tip of a hemostat.

In the distal approach, branches of the facial nerve were identified through a curvilinear incision made 3.5 to 4.0 cm anterior to the ear. Superiorly, the incision extended to an imaginary line connecting the

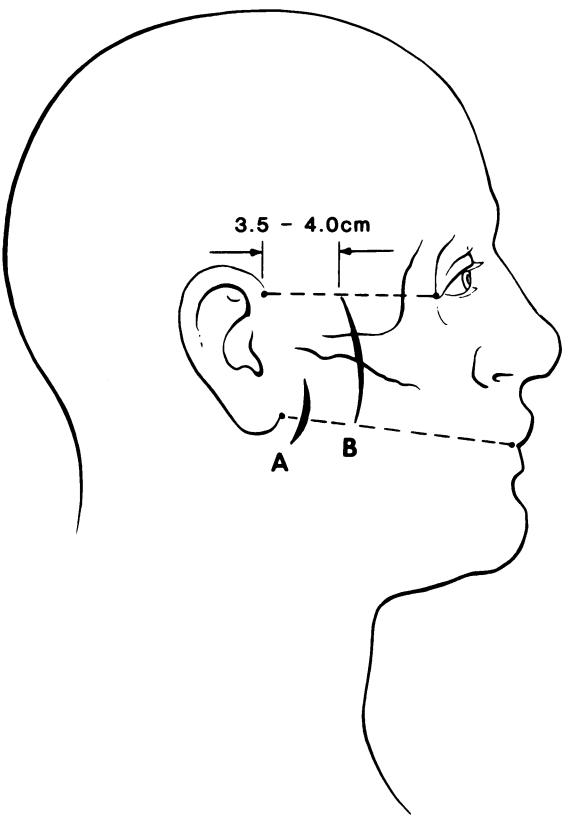

FIGURE 1
Incisions. A: For proximal neurectomy. B: For distal neurectomy.

superior insertion of the pinna and the lateral canthus. Inferiorly, the incision extended to an imaginary line connecting the inferior insertion of the pinna and the angle of the mouth (Fig 1B). After division of skin, subcutaneous tissue, and fascia, attention was directed to the first two branches of the bifurcation of the facial nerve—the temporal and zygomatic nerves. These were isolated, transected as proximally as possible, and avulsed as distally as possible. Careful attention was then given to avulsion of the buccal nerve branches that, on facial nerve stimulation, appeared to play a role in the blepharospasm.

The less-extensive myectomy procedure (type I) was used during the early years of the period studied. For all but one patient, this procedure

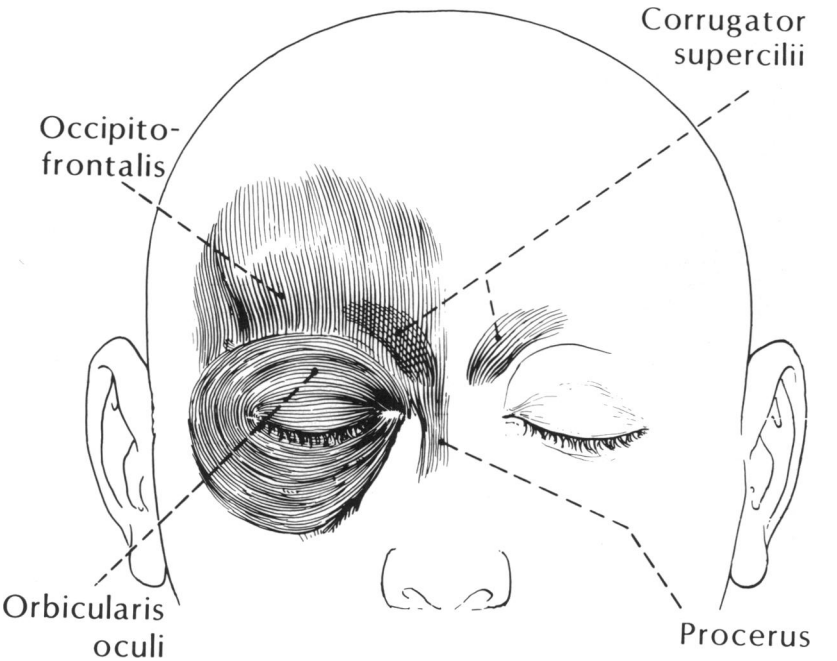

FIGURE 2
Major muscle groups excised during myectomy.

was performed under general anesthesia. It consisted primarily of removal of a portion of the pretarsal and preseptal orbicular muscles of the eye. Occasionally, the superciliary corrugator muscle was excised as well.

From 1981 through 1984, a more extensive myectomy procedure (type II), with only slight modification from that described by Gillum and Anderson,[7] was used (Fig 2). The type II myectomy was performed under local anesthesia. It involved the fashioning of supraciliary browplasty and blepharoplasty markings followed by injection of local anesthetic (Fig 3). After the browplasty incisions were made, the occipitofrontal and orbital orbicular muscles were excised. A connecting browplasty incision then facilitated removal of the procerus and superciliary corrugator muscles. Blepharoplasty incisions followed, and pretarsal and preseptal orbicular muscles were excised (Fig 4). Retraction of the eyelid skin allowed the dissection from the blepharoplasty incisions to be carried up to the browplasty incision. Browplasty and repair of levator aponeurosis disinsertion and lateral canthal tendon laxity were then performed, if needed. Before

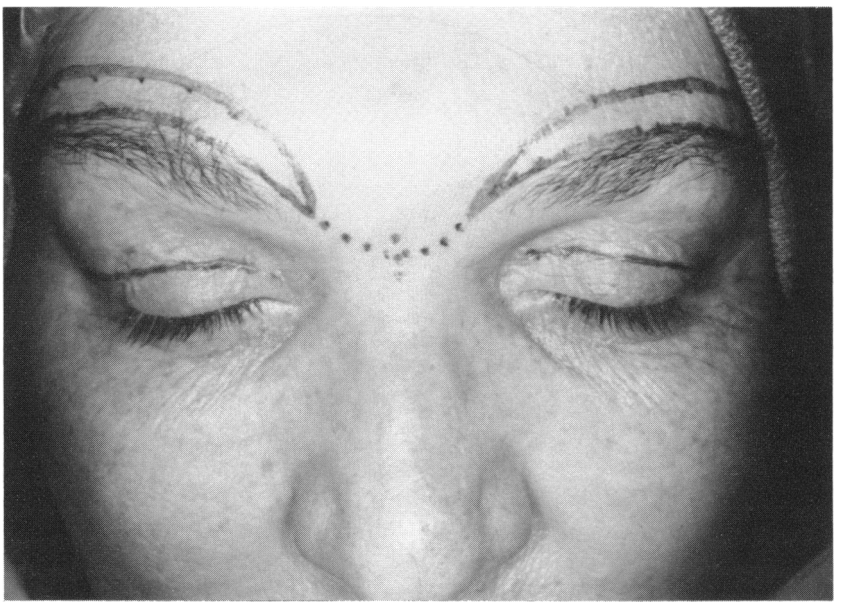

FIGURE 3
Markings for browplasty and blepharoplasty incisions used for myectomy.

skin closure, subcutaneous drains were placed in both the browplasty and blepharoplasty incisions.

BOTULINUM TOXIN INJECTION

The informed consent forms and protocol for use of botulinum toxin injection in the treatment of patients with blepharospasm were approved by the Mayo Clinic Institutional Review Board. Informed consent was obtained from every patient who volunteered to participate in the study. Crystallized botulinum A toxin was provided by Scott[9] (Oculinum, lots 79-11-19 and 79-11-20). Immediately before use, it was diluted with isotonic saline to a concentration of 2.5 U of toxin per 0.1 ml. A total of 12.5 U of toxin was injected into the muscles around each eye (Fig 5). In the upper eyelids, a 0.125-ml bolus of solution (3.125 U of toxin) was injected just beneath the skin near the upper nasal border of the tarsus, and another bolus (3.125 U of toxin) was injected near the upper temporal tarsal edge. In the lower eyelids, 0.125 ml (3.125 U of toxin) was delivered along the temporal half of the pretarsal orbicular muscle and 0.125 ml (3.125 U of toxin) was placed in the lateral canthal region within 1 cm

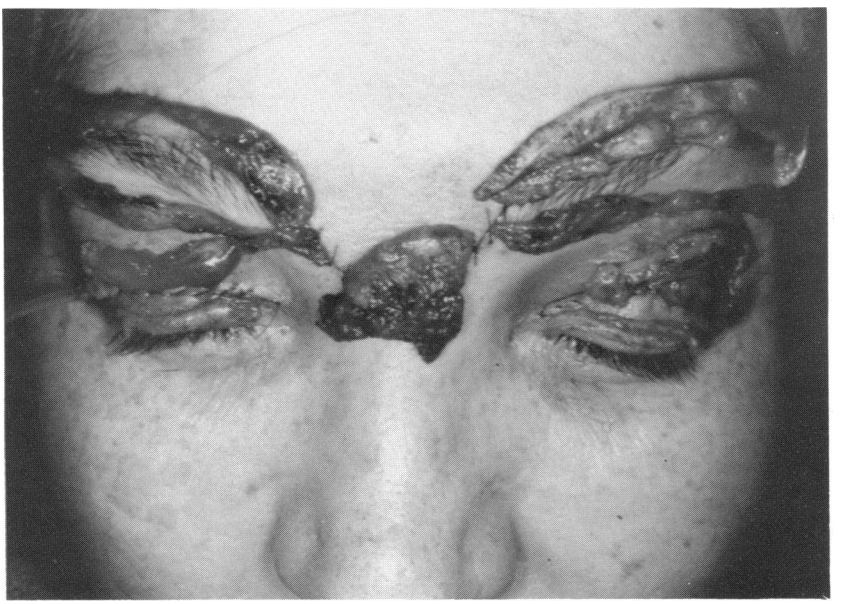

FIGURE 4
Browplasty and blepharoplasty incisions are closed. Muscle tissue excised is placed in approximate anatomic position to demonstrate muscle mass actually removed. Pretarsal, preseptal, and orbital orbicular muscles and procerus and superciliary corrugator muscles are shown.

of the lateral canthal angle and beneath the horizontal raphe. The toxin was administered through a tuberculin syringe with a 0.5-inch 30-gauge needle. No local anesthetic was required.

One patient had the injections only in the upper eyelids, another had them only in the lower eyelids, and eight patients underwent unilateral injection initially with the contralateral side being treated at a later time. With these exceptions, the procedure, sites of injection, concentration of toxin, and total dose of toxin injected into the muscles around each eye did not vary. Previous therapy, preinjection impairment due to blepharospasm, and the value of botulinum toxin injection in lessening symptoms were evaluated in a manner similar to that used to evaluate neurectomy and myectomy.

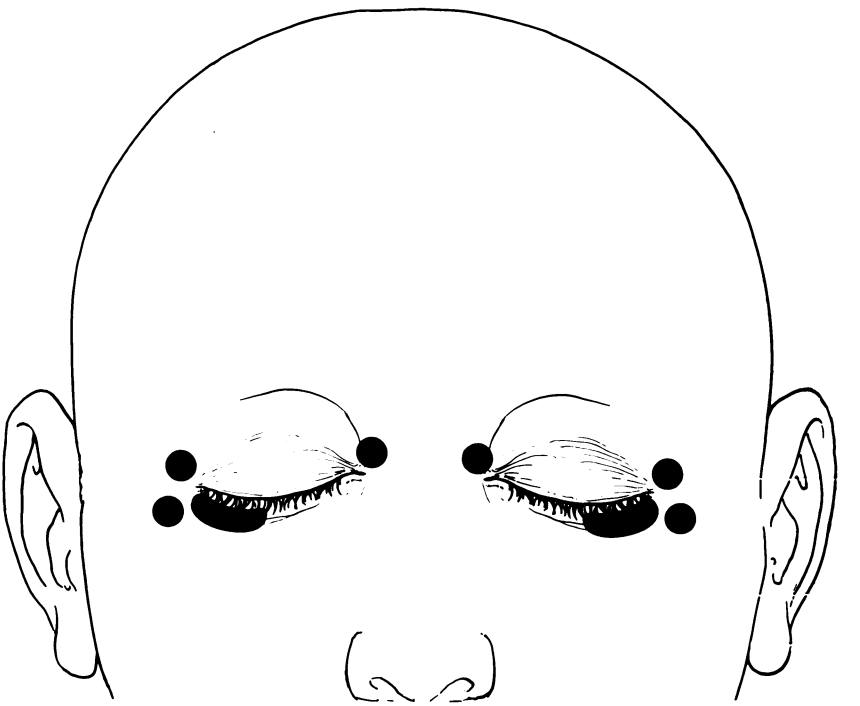

FIGURE 5
Sites for botulinum toxin injection in upper and lower eyelids.

RESULTS

NEURECTOMY AND MYECTOMY

A total of 123 patients underwent neurectomy or myectomy at the Mayo Clinic during the 35-year period, 1950 through 1984: 27 patients had proximal neurectomy, 48 had distal neurectomy, 10 had the less-extensive type I myectomy, and 38 had the more-extensive type II myectomy (Fig 6). The type I myectomy procedure was used only from 1955 through 1967. Between 1968 and 1980, only proximal and distal neurectomy procedures were performed. From its introduction in 1981 through 1984, type II myectomy was the most frequently performed operation. Increases in the annual number of patients who underwent initial operation coincided with the transitions from mainly type I myectomy to neurectomy procedures in 1967, and from mainly neurectomy to type II myec-

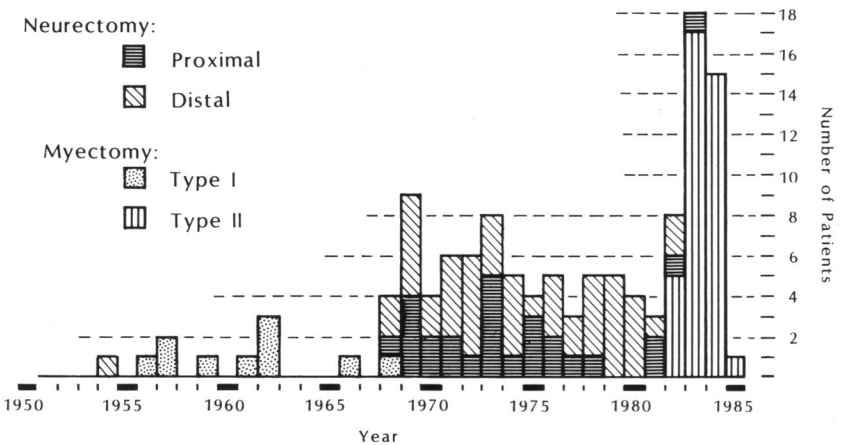

FIGURE 6
Distribution of patients by year of initial operation for blepharospasm at Mayo Clinic (123 patients), 1950 through 1984. Numbers of patients: proximal neurectomy, 27; distal neurectomy, 48; type I myectomy, 10; type II myectomy, 38.

tomy procedures in 1981. Eight surgeons performed all 123 of the initial operations; three of these surgeons performed all 27 of the proximal neurectomy procedures and none of the other procedures, and two other surgeons performed 92 of the 96 distal neurectomy and type I and type II myectomy procedures.

Overall, there were 61 men and 62 women; the proportion of each did not differ significantly between the groups (Table I). Similarly, there were no statistically significant differences between groups with regard to age at operation or duration of blepharospasm before operation. The group median ages ranged from 58 to 67 years, and group median durations of blepharospasm prior to operation ranged from 3 to 4 years. Because the comparisons of primary interest were between patients who had proximal or distal neurectomy or type II myectomy, all further analyses focused on these three groups only.

The levels of preoperative impairment due to blepharospasm were remarkably similar among all three groups. Approximately 85% of the patients were categorized as having had marked impairment and 15% as having had moderate impairment. No patient had preoperative impairment that was considered to be mild. Most patients had tried one or more medications or had undergone some other treatment before their first operation at the Mayo Clinic (Table II). The groups were comparable with

TABLE I: AGE, SEX, AND DURATION OF BLEPHAROSPASM* IN PATIENTS WHO UNDERWENT SURGICAL TREATMENT OF BLEPHAROSPASM AT MAYO CLINIC, 1950-1984

	PROXIMAL NEURECTOMY (n = 27)	DISTAL NEURECTOMY (n = 48)	TYPE I MYECTOMY (n = 10)	TYPE II MYECTOMY (n = 38)
Age (yr)				
Range	48-76	40-77	45-82	52-84
Median	61	62	58	67
Sex (no)				
Males	13	26	3	19
Females	14	22	7	19
Duration preoperative (yr)				
Range	1-13	< 1-18	< 1-9	< 1-25
Median	3	3	3	4

*None of the differences between groups was statistically significant at $P < 0.05$ level.

regard to the proportions of patients who had had the various prior treatments.

Significant recurrent or residual blepharospasm after the initial operation (postoperative impairment from blepharospasm still moderate or marked) occurred more frequently ($P < 0.01$) among those who had had a proximal neurectomy than among those who had had a distal neurectomy (Table III). Patients who underwent type II myectomy fared much better than those who had either of the neurectomy procedures ($P < 0.01$ for both comparisons). To determine whether the longer mean follow-up of

TABLE II: MOST COMMON TYPES OF TREATMENT FOR BLEPHAROSPASM BEFORE INITIAL OPERATION AT MAYO CLINIC, 1950-1984

	PROXIMAL NEURECTOMY (n = 27)		DISTAL NEURECTOMY (n = 48)		TYPE II MYECTOMY (n = 38)	
TREATMENT*	NO	%	NO	%	NO	%
Medication	23	85	31	65	30	79
No treatment	4	15	12	25	6	16
Psychotherapy	2	7	8	17	5	13
Blepharoplasty	1	4	1	2	3	8
Neurectomy	1	4	3	6	0	0
Alcohol injection	0	0	3	6	1	3
Electroshock therapy	1	4	1	2	0	0
Myectomy	0	0	1	2	0	0
Biofeedback	0	0	0	0	1	3
Hypnosis	0	0	0	0	1	3
Acupuncture	0	0	0	0	1	3

*Several patients had more than one type of treatment. None of the differences between groups was statistically significant at the $P < 0.05$ level.

TABLE III: OCCURRENCE OF SIGNIFICANT RECURRENT OR RESIDUAL BLEPHAROSPASM AFTER INITIAL OPERATION FOR BLEPHAROSPASM AT MAYO CLINIC, 1950-1984

OPERATION*	*n*	PATIENTS WITH RECURRENT OR RESIDUAL BLEPHAROSPASM†	
		NO	%
Proximal neurectomy	27	21	78
Distal neurectomy	48	22	46
Type II myectomy	38	7	18

*Differences between proximal neurectomy and distal neurectomy groups and between distal neurectomy and type II myectomy groups were statistically significant ($P < 0.01$).

†Significant recurrent or residual blepharospasm was considered to be present when postoperative impairment due to blepharospasm was judged to be still moderate or marked. This was determined from the patients' responses to questions regarding ability to drive, read, watch television, perform household tasks, and continue with their usual occupations and from their physicians' comments in the medical records.

the patients who had neurectomy could account for any of these differences, the time intervals from operation to recurrence were examined. Unfortunately, these intervals could not be defined with sufficient precision to allow the use of Kaplan-Meier[13] survival analysis methods, but it was possible to determine that all but 2 of the 43 recurrences in the proximal and distal neurectomy groups occurred within 2 years after the initial operation; most occurred within 1 year. Follow-up for longer than 1 year postoperatively or until death, or recurrence of blepharospasm, was available for 24 of 27 patients (89%) in the proximal neurectomy group, 43 of 48 patients (90%) in the distal neurectomy group, and 36 of 38 (95%) in the type II myectomy group. Because most of the recurrences occurred within a short time after operation and because follow-up information for the first year after operation was available for a higher proportion of those who had type II myectomy, it seems unlikely that differences in length of follow-up could have had a significant adverse influence on the results.

Another measure of the success of the initial operations is provided by evaluation of the number and types of subsequent procedures required for management of recurrent or residual blepharospasm or for repair of eyelid or brow deformities (Table IV). For this analysis, all subsequent procedures other than injection of alcohol along the facial nerve were included, whether performed at the Mayo Clinic or elsewhere. The proportion of patients who had distal neurectomy and underwent one or more additional procedures (30 of 48, 62%) was greater than that (12 of 38, 32%) who had type II myectomy ($P < 0.01$). The largest difference between these groups was for procedures to correct eyelid or brow de-

TABLE IV: NUMBER AND TYPES OF SUBSEQUENT PROCEDURES PERFORMED ON PATIENTS WHO UNDERWENT SURGICAL TREATMENT OF BLEPHAROSPASM AT MAYO CLINIC, 1950-1984

	PROXIMAL NEURECTOMY (n = 27)	DISTAL NEURECTOMY (n = 48)	TYPE II MYECTOMY (n = 38)
For management of recurrent or residual blepharospasm			
Patients*	7 (26%)	24 (50%)	12 (32%)
Procedures†			
Neurectomy	6	42	2
Botulinum toxin injection	5	1	15
Myectomy	0	6	8
Microvascular decompression	1	0	0
Unknown	0	1	2
Total	12	50	27
Fore repair of eyelid or brow deformities			
Patients‡	1 (4%)	18 (38%)	1 (3%)
Procedures			
Browplasty	1	12	0
Ectropion repair	1	11	1
Tarsorrhaphy	2	6	0
Blepharoplasty	0	3	0
Medial canthoplasty	1	0	0
Total	5	32	1
Total patients‡	7 (26%)	30 (62%)	12 (32%)
Total procedures	17	82	28

*Difference between proximal neurectomy and distal neurectomy groups was statistically significant ($P < 0.05$) but difference between distal neurectomy and type II myectomy groups was not ($P > 0.05$).

†Two patients in proximal neurectomy group and nine in distal neurectomy group had unilateral neurectomy and at a later time had unilateral neurectomy on the contralateral side; these second procedures were included as subsequent procedures. Seven patients in myectomy group had subsequent myectomy procedures on lower eyelids; these second procedures were also included as subsequent procedures.

‡Differences between proximal and distal neurectomy groups and between distal neurectomy and type II myectomy groups were statistically significant ($P < 0.01$).

formities. After adjustment for group differences in number of patients, the total number of procedures also was greatest among patients who had distal neurectomy.

Not all of the patients with significant recurrent or residual blepharospasm (postoperative blepharospasm still moderate or marked) underwent additional procedures. Conversely, several patients with postoperative impairment defined as mild did elect to have additional procedures. The smallest proportion of patients who had subsequent procedures was among those in the proximal neurectomy group. Although the reasons for this are not entirely clear, the data regarding recurrence of blepharo-

TABLE V: PATIENTS' ASSESSMENT* OF VALUE OF SURGICAL TREATMENT OF BLEPHAROSPASM AT MAYO CLINIC, 1950-1984

	PROXIMAL NEURECTOMY (*n* = 27)		DISTAL NEURECTOMY (*n* = 48)		TYPE II MYECTOMY (*n* = 38)	
ASSESSMENT	NO	%	NO	%	NO	%
Helpful†	19	70	40	83	36	95
No value	6	22	7	15	2	5
Made situation worse	1	4	1	2	0	0
Unknown	1	4	0	0	0	0

*Patient assessment was determined from the responses to a questionnaire and from the physicians' comments in the medical records.

†Difference between proximal neurectomy and type II myectomy groups was statistically significant ($P < 0.05$). The other group differences were not statistically significant ($P > 0.05$).

spasm (Table III) and patient satisfaction with the operations (Table V) indicate that it was not because further treatment was not needed. One factor may have been the reluctance of the three surgeons who performed the initial operations to subject patients with blepharospasm to multiple operations.

The time intervals from initial operation to first subsequent procedure were reviewed to determine whether group differences in length of follow-up could have biased these results. Most of the first subsequent procedures performed on patients in the distal neurectomy group were done within 1 year after the initial operation, and only one was performed more than 3 years later. Kaplan-Meier[13] survival analysis of time to first subsequent procedure confirmed that adjustment for differences in length of follow-up did not result in any significant changes.

Each patient's assessment of the value of surgical treatment was recorded and analyzed (Table V). A majority of patients believed that the operations had been helpful; the largest proportion were in the type II myectomy group and the smallest, in the proximal neurectomy group. Although this finding is consistent with the presence of recurrent or residual blepharospasm (Table III), the data indicate that many patients who had recurrence still regarded the operations as helpful.

BOTULINUM TOXIN INJECTION

A total of 20 patients (7 men and 13 women) received botulinum toxin injections between November 19, 1984, and April 15, 1985. The ages ranged from 27 to 82 years (median, 67.5 years). Duration of blepharospasm prior to injection ranged from less than 1 year to 14 years. Preinjection impairment due to blepharospasm was graded as marked for 9 pa-

tients (45%), moderate for 10 patients (50%), an mild for 1 patient (5%). The intensity and force of eyelid and brow spasms were recorded prior to injection and correlated well with preinjection impairment as judged by ability to drive, read, watch television, and participate in other activities. Before injection, 19 patients had been treated with medication, 3 had had type II myectomy, and 1 had had type II myectomy and distal neurectomy. Four patients were included among the 123 patients who had undergone neurectomy or myectomy at the Mayo Clinic from 1950 through 1984.

Although these patients have been followed for only a short period (range, 1 to 21 weeks), several interesting observations have been made. All but one patient experienced significant relief of blepharospasm after the initial injection. The patient who did not respond had previously undergone myectomy procedures on both the upper and lower eyelids and had had several neurectomy procedures as well. Fifteen of the patients have been followed for longer than 10 weeks and 4 of these have noted some return of blepharospasm. One patient received a second botulinum toxin injection 20 weeks after the initial injection, another underwent a type II myectomy procedure 4 weeks after injection, and two others have noted a mild, gradual increase in blepharospasm but have not yet received further treatment.

Thus far, the number of complications has been few and none has been serious. One patient who had had Bell's palsy many years prior to the onset of blepharospasm, developed significant paralytic ectropion of the ipsilateral lower eyelid which lasted for approximately 3 weeks. Although most patients used artificial tears, clinically evident keratitis with fluorescein staining was observed in only one patient. None of the patients developed ptosis or ophthalmoplegia.

DISCUSSION

The importance of differentiating essential blepharospasm and other types of blepharospasm from other movement disorders affecting the face should be emphasized. For many patients with disabling blepharospasm, appropriate therapy has been delayed because their symptoms were attributed incorrectly to psychologic disturbances or to other causes. One contributing factor is that mildly increased blinking and benign tics or twitching of the eyelids occur frequently, whereas disabling blepharospasm is a relatively uncommon disorder. Increased awareness of blepharospasm, due in part to recent reports concerning myectomy[7,8] and botulinum toxin injection,[10,12] probably has helped to minimize this problem.

Essential blepharospasm usually begins insidiously; most patients exhibit bilateral involuntary movements of the upper face and eyelids. The term "Meige's syndrome" is used to describe blepharospasm that occurs in combination with dystonic movements of the lower face and neck. Blepharospasm can also be observed in association with Parkinson's disease, tardive dyskinesia, and various other movement disorders. In general, the symptoms tend to worsen with fatigue or involvement in social activities but often can be minimized by some distracting activity such as singing, chewing, speaking, or exerting pressure at a focal point on the brow or eyelid. The occasional presence of callus at these focal sites attests to the importance of this last distracting mechanism. Fortunately, the other conditions included in the differential diagnosis, such as benign tic, functional blepharospasm, hemifacial spasm, apraxia of eyelid opening, and blepharospasm due to ocular disease usually can be distinguished without difficulty on the basis of several clinical characteristics. Jankovic et al[2] recently reviewed these in detail. It was interesting to note that several patients in the present study had previously been misdiagnosed as having myasthenia gravis, although this is not generally included in the differential diagnosis.

The growth in number of operations performed annually for blepharospasm after 1980 (Fig 6) probably reflects several factors. Greater awareness of this disorder among physicians and the public may have resulted in more patients being referred to our group, but the main reasons for the increase probably relate more to introduction of the type II myectomy procedure. For several reasons, patients have found this procedure more appealing than the neurectomy procedures. First, local anesthesia is suitable (and preferable) for myectomy but not for neurectomy, because infiltrative anethesia would preclude use of electrical stimulation to identify the nerve branches to be extirpated. Second, the complications that occur with neurectomy differ from and are generally more undesirable than those associated with myectomy.

Lagophthalmos, ectropion of the lower eyelids, exposure keratopathy, accentuation of brow droop and dermatochalasis, and, perhaps most important, facial and lip paralysis can occur after neurectomy. Complications of myectomy include hemorrhage, partial anesthesia of the forehead from intraoperative trauma to the supraorbital neurovascular bundle, swelling, and overcorrection of aponeurosis repair, producing inability to achieve complete lid closure. In addition, all of the complications associated with blepharoplasty could be expected to occur with this procedure as well. Eyelid and brow deformities are usually not created during myectomy but rather are generally corrected. Although few patients have

declined myectomy because of concern over possible complications, many have declined or deferred neurectomy because of the possibility of facial paralysis.

As reflected by the data on previous therapy for blepharospasm (Table II), many different approaches—including medication, psychotherapy, biofeedback, and acupuncture—have been tried. None of these treatments has consistently been effective in relieving blepharospasm. Interestingly though, a few patients do seem to respond to these conservative measures. Whether this response indicates true effectiveness in selected patients or merely reflects variability in symptoms or relief of a functional component of the blepharospasm, remains unknown. Because occasional, but usually temporary, relief of symptoms can occur, most patients receive some other form of therapy before surgical treatment is considered.

The results of this study show that patients who underwent type II myectomy fared much better than those who had either proximal or distal neurectomy. Several factors tend to strengthen confidence in the accuracy of these findings. In general, the differences between the distal neurectomy and type II myectomy groups were large, particularly in regard to numbers of subsequent procedures. Furthermore, there were no obvious differences with regard to age, sex, duration or severity of blepharospasm, or other preoperative factors, and the follow-up information was exceptionally complete.

The data also suggest that distal neurectomy is a more effective procedure than the proximal approach, even though a smaller proportion of those in the proximal neurectomy group underwent subsequent procedures (Table IV). This finding does not indicate that further treatment was not needed but likely reflects the reluctance of the surgeons who performed proximal neurectomy to reoperate on patients with blepharospasm. Unfortunately, distal neurectomy requires much more time than proximal neurectomy, because dissection of the peripheral nerve branches must be performed slowly and meticulously. The mean times of operation in this study were 4 hours and 8 minutes for bilateral distal neurectomy and 1 hour and 41 minutes for bilateral proximal neurectomy.

In the distal neurectomy group, 30 of 48 patients (63%) underwent a total of 82 subsequent procedures to manage residual or recurrent blepharospasm or to repair eyelid or brow deformities. Yet, 40 of these 48 patients (83%) indicated that their operations had been helpful. Similar disparities also existed for proximal neurectomy and type II myectomy. Apparently, the surgical procedures are often viewed as helpful even when the beneficial effects are not sufficient to allow resumption of many daily activities or even when they are of short duration. Paradoxically,

some patients who by all measures had shown dramatic reduction of their blepharospasm after operation, complained bitterly about minimal amounts of residual spasm. Frequently, the residual spasm was present in the midfacial region contiguous to the lower eyelids.

Considering the drawbacks of neurectomy and myectomy, it is not surprising that initial reports regarding use of botulinum toxin injection for treatment of blepharospasm have met with considerable ethusiasm. Our results based on 20 patients indicate that the majority of patients improve markedly, but the beneficial effects are often temporary. This is consistent with the findings of Scott et al,[10] Frueh et al,[11] and Tsoy et al[12] who reported on a combined total of 96 patients treated for blepharospasm. Their data show that the relief of symptoms after the initial or subsequent injections lasts an average of 2 to 3 months. A few of their patients, and ours, developed exposure keratitis or ptosis, but no serious adverse effects have been reported by these other investigators and none were noted by us.

Although these initial results are very encouraging, they should be considered in relation to concerns regarding both safety and effectiveness. The possibility exists that a serious adverse effect may yet be discovered, particularly if some patients continue to recieve many injections over a course of several years. As a possible aid in the investigation of any systemic responses to toxin injection, we are beginning to save serum samples obtained before injection from all patients. Because of the potential risk of a serious adverse effect and also for reasons relating to costs, it is important that rigorous evaluation of the effectiveness of botulinum toxin therapy continue. However, this task is made difficult by variability in symptoms, occasional presence of a functional component to the blepharospasm, and lack of a well-defined end point for study. Even the more objective data from measurements of lid forces or electromyographic or video recordings can be subject to biases and may not always correlate well with changes in ability to perform daily activities.

If further investigation continues to support the safety and effectiveness of botulinum toxin, it will almost certainly become important in the management of patients with blepharospasm. Because type II myectomy appears to be the most effective surgical procedure, consideration needs to be given to whether these therapeutic modalities should be used alone or in some combination. The benefits of botulinum toxin therapy tend to be temporary, whereas those of myectomy are more long-lasting. At the time of myectomy, eyelid and brow deformities resulting from long-standing blepharospasm or involutional change can be corrected. Botulinum toxin injection, on the other hand, can accentuate such deformities

because of its paralytic action. Another consideration is that scarring or the lack of muscle after myectomy may compromise future use of botulinum toxin. All of these factors must be carefully assessed in order to determine the optimal approach to the long-term care of patients with blepharospasm.

SUMMARY

From 1950 through 1984, 123 patients underwent surgical treatment of blepharospasm at the Mayo Clinic. During this period, four different operations (proximal and distal neurectomy and two types of myectomy) were used. Significant recurrent or residual blepharospasm was observed more frequently ($P < 0.01$), and need for subsequent operations was greater ($P < 0.01$), among patients who had undergone distal neurectomy than among those who had had myectomy. These data support the view that myectomy is a more effective procedure than neurectomy. Initial results with botulinum toxin injection seem to indicate that it is an effective short-term treatment for blepharospasm. However, its long-term efficacy and safety need further study, as does the role it should play in combination with myectomy.

ACKNOWLEDGMENTS

We thank Ms Carol A. Siegenthaler and Ms Diane F. Nelson for their help in collecting the follow-up information, Ms Shirley A. Richardson for assistance in preparing the manuscript, and the patients and physicians who responded so promptly to our questionnaires.

REFERENCES

1. Henderson JW: Essential blepharospasm. *Trans Am Ophthalmol Soc* 1956; 54:453-520.
2. Jankovic J, Havins WE, Wilkins RB: Blinking and blepharospasm: Mechanism, diagnosis, and management. *JAMA* 1982; 248:3160-3164.
3. Reynolds DH, Smith JL, Walsh TJ: Differential section of the facial nerve for blepharospasm. *Trans Am Acad Ophthalmol Otolaryngol* 1967; 71:656-664.
4. Dortzbach RK: Complications in surgery for blepharospasm. *Am J Ophthalmol* 1973; 75:142-147.
5. Frueh BR, Callahan A, Dortzbach RK, et al: The effects of differential section of the VIIth nerve on patients with intractable blepharospasm. *Trans Am Acad Ophthalmol Otolaryngol* 1976; 81:OP595-OP602.
6. Battista AF: Blepharospasm: A surgical procedure for therapy. *Ophthalmic Surg* 1981; 12:823-829.
7. Gillum WN, Anderson RL: Blepharospasm surgery: An anatomical approach. *Arch Ophthalmol* 1981; 99:1056-1062.

8. McCord CD Jr, Coles WH, Shore JW, et al: Treatment of essential blepharospasm. I. Comparison of facial nerve avulsion and eyebrow-eyelid muscle stripping procedure. *Arch Ophthalmol* 1984; 102:266-268.
9. Scott AB: Botulinum toxin injection of eye muscles to correct strabismus. *Trans Am Ophthalmol Soc* 1981; 79:734-770.
10. Scott AB, Kennedy RA, Stubbs HA: Botulinum A toxin injection as a treatment for blepharospasm. *Arch Ophthalmol* 1985; 103:347-350.
11. Frueh BR, Felt DP, Wojno TH, et al: Treatment of blepharospasm with botulinum toxin: A preliminary report. *Arch Ophthalmol* 1984; 102:1464-1468.
12. Tsoy EA, Buckley EG, Dutton JJ: Treatment of blepharospasm with botulinum toxin. *Am J Ophthalmol* 1985; 99:176-179.
13. Kaplan EL, Meier P: Nonparametric estimation from incomplete observations. *J Am Stat Assoc* 1958; 53:457-481.

DISCUSSION

Dr Alan B. Scott. Lots of us have blepharospasm—or at least we have our eyes closed to this disorder. It is not a rare disorder affecting a few neurotic crazies as I once thought. But instead, as Doctor Waller has clarified, a serious cause of visual impairment affecting thousands of otherwise normal adults, many at the peak years of their productivity and enjoyment of life. I thank Doctor Waller for his fine paper which puts into clear perspective various treatments available for benign essential blepharospasm.

What happens to cause blepharospasm? Nobody knows for sure. Blinking movements are relatively stereotyped. The brain typically assigns only a small population of neurons to control such movements. Each of us loses a few thousand neurons everyday. It is not difficult to suppose that persons with particular susceptibility will lose just the crucial neurons in such a small area whose function cannot be readily replaced by new connections. Such a hypothesis lends itself to explain why the disorder happens in otherwise normal people, most always at middle or later age and why it slowly progresses for a few years. Of course, a few cases are associated with strokes or Parkinsonism, and there are additional mechanisms of injury.

Centrally acting sedative or anti-epileptic drugs are of some definite help in a few patients and well worth a try in all the milder cases. Cutting a hole in the closed eyelid, once proposed, has never developed a following. Peripherally acting treatments cut the nerve surgically, cut out the muscle surgically, or block the nerve signal chemically by botulinum injection. Doctor Waller has clearly shown us that cutting out the nerve is inferior to removing the muscle. No one is going to do a better comparison of these treatments than Doctor Waller's paper which will stand as the definitive work. The nerves regrow with incredible capacity and the muscle itself regenerates and hypertrophies from small residual fragments with impressive power. After we paralyze the extraocular muscle with botulinum toxin, the muscle, typically takes about 6 months to recover to its full original strength. But the patient is symptomatic at 2 or 3 months, when the force was typically recovered to a quarter or third of the original muscle strength. It is

clear, therefore, that muscle excisional surgery must be quite complete to have lasting effects. I am not quite as sanguine as Doctor Waller about the low rate of blepharospasm following surgical muscle excision. Perhaps in the meticulous masterful Mayo manner, the muscle is correctly and fully excised. This skill is not sufficiently widespread, and thus we see, for injection, 20% of our blepharospasm patients following surgery.

How should we look upon injection? Nearly all of the 600 patients treated by various investigators have been benefited. The treatment itself is simple, and as far as we can tell, indefinitely repeatable. At one time, it seemed as though this need to reinject made the treatment a failure. But as one of my patients who is diabetic said, "I have to give myself insulin everyday, doing this every 2 or 3 months is nothing." Thus, it is a matter of attitude whether the patient or the doctor gets tired of injecting. Two out of our 60 patients have elected to have surgery, but in the practices of those physicians who do much lid surgery, this failure rate of injection will undoubtedly be higher.

Finally, some of these patients have a true apraxia of lid movement similar to what Doctor Cogan described, but which is evident only after the orbicularis muscles have been paralyzed. Their blepharospasm is one sign of a more general dystonia and neurologic degeneration. Further clinical experiene will tell what helps best for them.

DR ROBERT WALLER. I would like to thank Doctor Scott for his kind words. It was of interest that the patient he discussed in his presentation was very young. While the mean age for most blepharospasm patients is obviously much older, we do see young patients with ill-defined movement disorders, part of which includes blepharospasm. These patients are often extremely difficult to manage.

The use of toxin may be of special importance in the young. Many of these patients wish to avoid scars from browplasty or blepharoplasty, and botulinum toxin therapy, of course, has the potential to serve this purpose.

The approach to the surgical myectomy can be through routes other than the brow. Some surgeons, such as Doctor Frueh from Ann Arbor and Doctor McCord from Atlanta have advocated the coronal approach to the muscle excisions and they find this to be a reasonable approach.

I agree with Doctor Scott that the first approach to treatment for the blepharospasm patient is consideration of drug therapy. Most of the drugs cause side effects which far outweight the benefits they provide. We have just not had much success with drug therapy although it certainly is worth an attempt prior to recommending botulinum toxin therapy or surgery.

There are some efforts on the part of a few to be more objective about measuring our successes. Doctor Frueh is measuring orbicularis force generation with some sophisticated instrumentation. We have begun to look at pre- and post-treatment electromyography following facial nerve stimulation. Somehow, we need to find a better way to assess the results of all of our treatment modalities. I thank you very much for the opportunity to present this paper and thank Doctor Scott as well.