

Surgical Treatment of Migraine Headaches by Corrugator Muscle Resection

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The authors, a plastic surgeon (Dirnberger) and a neurologist (Becker), conducted this study after reading the article by Bahman Guyuron et al. in the August 2000 issue of *Plastic and Reconstructive Surgery* (106: 429, 2000). Sixty patients were operated on between June of 2001 and June of 2002; postoperative follow-up ranged between 6 and 18 months. Patients' charts were reviewed to confirm the diagnosis of migraine headache according to the criteria of the International Headache Society. Sixty patients (13 men and 47 women) from Austria and four neighboring countries took part in the study. The patients were divided into three groups, based on the severity of their migraines: group A comprised patients with up to 4 days of migraine per month; group B included patients with 5 to 14 days of migraine per month; and group C was composed of patients with more than 15 days of headache per month ("permanent headache") or evidence of drug abuse and drug-related headaches. The effectiveness of the operation was evaluated using the following factors: percentage reduction of headache days; percentage reduction of drugs; percentage reduction of side effects, severity of headaches, and response to drugs; and patient grade of personal satisfaction, using a scale from 1 to 5 [1 = excellent (total elimination of migraine headache) to 5 = insufficient or no improvement].

From the entire group of 60 patients, 17 (28.3 percent) reported a total relief from migraine, 24 (40 percent) reported an essential improvement, and 19 (31.7 percent) reported minimal or no change. Patients with a rather mild form of migraine headache had a much better chance (almost 90 percent in group A and 75 percent in group B) to experience an improvement or total elimination of migraine than those patients ($n = 27$) from group C with severe migraine, "permanent headaches," and drug-induced headaches. Contrary to the reports by Guyuron, 11 patients who had a very favorable response immediately and in the first weeks after the operation experienced a gradual return of their headaches to preoperative intensity after about 4 postoperative weeks. After 3 months, the results in all patients could be declared permanent. All side effects, such as paraesthesia in the frontal region, disappeared in all patients within 3 to 9 months. (*Plast. Reconstr. Surg.* 114: 652, 2004.)

The article on the surgical treatment of migraine headaches by Bahman Guyuron et al.¹ in the August 2000 issue of the *Journal* generated great interest in the senior author (Dirnberger), as he not only is a plastic surgeon but also has experienced migraine headaches for the last 20 years. He decided immediately to undergo this operation himself.

The operation was performed in February of 2001 and the result was striking. His migraine attacks were reduced by about 80 percent in frequency as well as severity. All side effects, such as nausea and intolerance to noise, disappeared completely, and his quality of life had practically returned to its premigraine era levels.

To ensure that the effect of the intervention was a lasting one, an observation period of 6 months was allowed to pass before it was decided to commence treatment of other migraine patients. Following publication of a brief report in a newspaper, the interest of migraine patients in the new treatment was overwhelming, but it was decided to operate only on patients with a history and symptoms of migraine correlating to the standards of the International Headache Society. The charts of all patients were reviewed by a neurologist (Becker); they were examined for various parameters, as shown in Table I.

PATIENTS AND METHODS

Between August of 2001 and July of 2002, 60 patients underwent surgical treatment for migraine headaches. All had symptoms of classic migraine according to the standards of the

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TABLE I
Migraine Patients Record

Preoperative Data					Postoperative Data					
Patient No.	Initials	Sex	Age (yrs)	Severity*	Drugs	Follow-Up (mo)	Personal Satisfaction	Headache Reduction (%)	Medication Reduction (%)	Symptoms
54	St.A.	F	37	A	Non spec.	15	3	0	0	Fewer
43	P.S.	M	62	A	Non spec.	15	3	33	33	Fewer
40	O.S.	F	33	A	Triptanes + non spec.	13	1	100	100	0
41	P.W.	M	74	A	Non spec.	14	2	50	60	Fewer
15	F.S.	F	53	A	Triptanes + non spec. (DA)	9	2	60	80	Fewer
11	B.U.	F	36	A	Non spec.	8	2	90	50	Fewer
8	Br.H.	F	38	A	Ergot + triptanes	13	5	0	0	Equal
13	D.R.	F	39	A	Triptanes	15	1	100	100	0
23	Hr.M.	F	33	A	Triptanes	16	3	70	60	Equal
59	W.G.	F	52	B	Non spec.	16	2	70	50	Fewer
53	Sch.M.	F	45	B	Triptanes	14	1	100	100	0
55	St.R.	F	24	B	Triptanes + ergot	13	1	100	80	Fewer
56	T.G.	F	64	B	Triptanes + ergot	8	2	50	80	Equal
57	V.E.	F	49	B	Ergot + non spec.	7	3	30	30	Fewer
48	S.C.	M	40	B	Triptanes + ergot	12	1	100	100	0
49	Sw.A.	F	55	B	Ergot	17	1	80	80	Fewer
46	S.M.	M	57	B	Triptanes + non spec.	12	5	0	0	Equal
39	S.A.	F	39	B	Triptanes	10	3	0	20	Fewer
35	M.D.	F	59	B	Triptanes	18 MFI	5	0	0	Equal
36	N.I.	F	61	B	Triptanes	6	2	80	60	Fewer
37	N.L.	M	54	B	Triptanes	16 MFI	5	0	0	Equal
31	L.A.	F	40	B	Triptanes + non spec.	14	3	30	20	Fewer
32	M.C.	F	62	B	Ergot + non spec.	12	1	100	100	0
24	H.J.	F	33	B	Non spec.	18	1	100	100	Fewer
22	Ho.A.	F	26	B	Triptanes + non spec.	16	5	0	0	Equal
19	H.A.	F	44	B	Triptanes + non spec. (DA)	9	5	0	0	Equal
14	D.M.	F	36	B	Ergot + non spec. (DA)	8	2	75	75	Equal
9	H.M.	F	71	B	Ergot + triptanes	9 MFI	5	0	0	Equal
10	H.S.	F	41	B	Ergot	13	1	100	100	0
1	A.D.	F	61	B	Non spec.	18	1	100	100	0
2	A.E.	F	67	B	Triptanes	16	3	50	90	Fewer
3	B.H.	F	64	B	Ergot (DA)	10	1	90	90	Fewer
4	B.A.	F	49	B	Triptanes	14	1	90	90	0
5	B.M.	F	39	C	Ergot (DA)	9	3	75	50	Fewer
6	B.R.	M	64	C	Ergot + non spec. (DA)	11	1	100	100	0
7	B.D.	F	30	C	Ergot + triptanes	15	3	50	50	Fewer
12	D.E.	F	46	C	Ergot + non spec. + triptanes (DA)	16	2	90	90	Fewer
16	F.A.	M	41	C	Triptanes + non spec.	16 MFI	5	0	0	Equal
17	G.O.	M	61	C	Ergot + non spec. (DA)	9	2	80	80	Fewer
18	G.M.	F	72	C	Ergot + non spec. (DA)	10	5	0	0	Equal
20	H.M.	F	40	C	Ergot (DA)	9 MFI	4	20	10	Equal
21	Hat.A.	F	40	C	Triptanes + ergot	12 MFI	5	0	0	Equal
25	I.H.	F	67	C	Triptanes + non spec. (DA)	13	1	100	100	0
26	K.K.	F	65	C	Triptanes + non spec.	10	3	80	50	Fewer
27	K.M.	M	40	C	Triptanes + non spec. (DA)	16	2	30	60	Fewer
28	K.H.	M	69	C	Triptanes + ergot + non spec. (DA)	7	2	90	70	Fewer
29	L.M.	F	64	C	Triptanes + non spec.	18	5	0	0	Equal
30	L.G.	F	80	C	Triptanes + ergot (DA)	10 MFI	5	0	0	Equal
33	L.E.	F	52	C	Ergot + non spec. (DA)	18 MFI	5	0	0	Equal
34	M.W.	M	63	C	Ergot	13	2	60	60	Fewer
38	N.H.	F	33	C	Ergot (DA)	17 MFI	5	0	0	Equal
42	Id.H.	F	48	C	Ergot (DA)	10	1	100	100	0
44	R.S.	F	37	C	Ergot + non spec.	16	3	50	50	Fewer
45	R.M.	F	39	C	Ergot	9	1	100	100	0
47	S.E.	F	40	C	Triptanes (DA)	12 MFI	5	0	0	Equal
50	S.B.	F	61	C	Triptanes + ergot	13	5	0	0	Equal
51	St.M.	F	32	C	Ergot	18	3	70	50	0
52	S.P.	M	66	C	Triptanes + non spec.	7 MFI	5	0	0	Equal
58	W.F.	M	60	C	Triptanes + ergot	13	5	0	0	Equal
60	Z.M.	F	37	C	Triptanes + non spec.	17	1	100	90	Fewer

Non spec., nonspecific drugs; Ergot, ergotamine; DA, drug abuse; MFI, migraine-free interval.

* Grade of severity: A, 1 to 4 days of migraine per month; B, 5 to 14 days of migraine per month; C, more than 15 days of migraine per month.

International Headache Society. They were informed that the operation was still experimental, as only one scientific article had been published so far.¹ The fact that the surgeon (Dirnberger) performing the operation had been operated on himself with great success naturally made the patients' decision much easier, although they knew that about 20 percent or more of them might not experience any success at all.

Preoperative Questionnaire

Patients completed a preoperative questionnaire that collected data on age, sex, type of migraine (aura or nonaura), side effects (nausea and vomiting), symptoms (olfactory and/or ocular), age at onset, frequency per month (in days), inability to work (in days), types of drugs used (ergotamine, triptanes, nonspecific drugs), amount of drugs used per month, other neurological disorders, history of head trauma, and history of meningitis.

As the patients came from Austria and four neighboring countries, it quickly became clear that it would be impossible to obtain clear numbers, especially concerning the number of days with migraine headaches as well as the type and amount of medicine taken to suppress the headaches. Patients were therefore divided into three groups. Group A comprised patients with up to 4 days of migraine per month ($n = 9$). Group B included patients with 5 to 14 days of migraine per month ($n = 24$). Group C was composed of patients with 15 or more days of headache per month or "permanent headache," with extreme drug consumption and symptoms of drug-dependent headaches ($n = 27$, including 18 with drug-related headaches).

As it appeared to be difficult for many patients to explain whether or not they had an aura, we decided to drop this question for further evaluation.

Operative Method

All patients were operated on by the same surgeon (Dirnberger) using the same technique. The corrugator supercilii muscle was resected as recommended by Bahman Guyuron through an incision in the upper eyelid.^{2,3} In order to remove all muscular structures around the supratrochlear nerve and its ramifications, which appeared to compress the nerve, total or at least subtotal resection of the

corrugator and depressor muscles was performed, using 4.5 times loupe magnification.

Patients were put under sedo-analgesia by an anesthesiologist using 0.5% Xylocaine with epinephrine as local anesthetic. All patients were treated in a day clinic and left the hospital about 6 hours postoperatively.

In all patients, the corrugator muscle was removed on both sides, even in patients who declared that they were experiencing their headaches strictly on one side. The intent was to prevent a possible later shift of their migraine to the other side of the head.

Although typical blepharoplasty incision and skin resection were performed, in no case was the orbital septum opened to remove orbital fat, for fear of additional bleeding, which may have caused prolonged postoperative swelling or additional scar formation around the supratrochlear nerves.^{4,5}

Both the supraorbital and supratrochlear nerves were localized, but no effort was made to perform a preparation of the supraorbital nerve. As soon as the supratrochlear nerve was observed, the author switched to a microsurgical technique, using 4.5 times loupe magnification. Small vessels were coagulated by bipolar diathermy. Although care was taken not to hurt the nerve, in seven cases a partial dissection of the supratrochlear occurred; this was mainly due to bleeding that was sometimes quite heavy, making the preparation difficult. In all cases, a soft rubber drain was left in place for a few hours postoperatively. No hematoma was observed in any case. All patients received cool wet soaks over their eyes, which they had to change frequently during the first 12 hours; thus, postoperative bleeding and swelling were kept to a minimum. The sutures were removed 1 week after the intervention.

The preoperative evaluation showed that the majority of patients had been having strong migraine headaches for years and had already used practically all kinds of treatment, including acupuncture, diet programs, and clinical drug withdrawal. Thirty-four patients stated that they were forced to bed rest and/or sick leave by their attacks; 13 patients in group C complained of "permanent headaches" and showed symptoms of drug-related headaches.

Ten patients showed signs of classic "ergotism," which is caused by taking large amounts of ergotamine drugs over a period of years. One woman had developed a rectovaginal fis-

tula after practically daily use of ergotamine suppositories (Avamigran suppositories).

All 60 patients reported having the typical accompanying symptoms, especially nausea and dejection.

RESULTS

Postoperative Evaluation

The patients were asked to keep a postoperative migraine diary for 4 weeks. After 6 months, a postoperative questionnaire was sent to them for an in-depth evaluation of the postoperative result (Fig. 1).

During our evaluation of the questionnaire responses, we realized that it was frequently difficult for the patients to grade their postoperative results, as most of them were accustomed to pain that was even severe and discomfort that had lasted for years. Even a moderate reduction of accompanying symptoms such as nausea or a slight reduction of the severity of the headaches with the ability to work was highly appreciated. Patients naturally rated these improvements with a higher grade of "personal satisfaction."

We set a rather high standard. Only a 30 percent reduction in the number of headache days and/or a 30 percent reduction in the amount of medicine taken, at a minimum, was considered a successful outcome of the operation. We also dropped the grade 4 level of minimal patient satisfaction and included these responses with the unsuccessful cases (grade 5) (Table II).

Because of the difficulty inherent in any "objective grading" of pain, we decided to give individual patient ratings preference over the strictly "objective data" of headache days and

drug consumption, because as we know, these data are also highly individual and hardly controllable.

For some patients, it is of major importance to be able to go to work, even on days of migraine headache, albeit in a milder form and without strong side effects and symptoms. For other patients, their expenses for triptanes dropped significantly; the costs for these drugs can become quite a burden for a patient with severe migraine, so this economic effect will show up as a good grade of individual satisfaction. Because migraine affects the daily lives of the patients within their families, among their friends, and at their jobs so tremendously, even a rather moderate reduction of pain and the associated complaints is highly appreciated.

Relationship between Patient Age and Postoperative Satisfaction

The result of the operation was measured by comparing patient age with individual satisfaction. The results show that there is a slightly smaller chance of 5 percent that older people might not benefit from the operation to the same extent as patients under the age of 60 years. Nevertheless, two out of three patients (67 percent) experienced a substantial or total relief of their headaches (Table III).

Relationship between Severity of Migraine and Postoperative Satisfaction

Patients in group A (mild form of migraine) had an almost 90 percent chance of getting total or at least essential relief; this chance dropped markedly with the severity of the migraine. In group B, 75 percent had a realistic hope of experiencing this result, while group C patients had a worse chance by far—only slightly more than half of them (55.6 percent) profited from the operation. [The biostatistical control (two chi-square tests) showed that the results for patient age and postoperative satisfaction are nonsignificant ($p = 0.8336$). The results for severity of migraine and postoperative satisfaction are not significant, but the p value of 0.1162 indicates some support.]

DISCUSSION

Other Factors and Observations Related to the Postoperative Result

The migraine-free interval. During the postoperative workup it became apparent that in 11 patients who had reported a total cessation or

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1. Did you experience a sudden, a gradual, or no relief of migraine headaches?
 2. Did side effects/symptoms such as nausea, vomiting, irritability, and so on change, disappear, or not change?
 3. Did the migraine headaches change in frequency and/or severity?
 4. Number of headache days per month, percent reduction in headache days?
 5. Percent reduction in medicine use?
 6. Personal satisfaction with the result of the operation as a grade of quality of life (comparable to school-grades):
1 = excellent (total elimination of migraine headaches)
2 = good
3 = fair (considerable improvement)
4 = slight improvement
5 = no improvement
 7. Postoperative numbness or dysesthesia in the frontal region
 8. Complications or undesirable side effects
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FIG. 1. Postoperative questionnaire.

TABLE II
Results

	90–100%	50–90%	Below 50%	None
Reduction of headache days after 6 months, %	31.7 (n = 19)	26.7 (n = 16)	8.3 (n = 5)	33.3 (n = 20)
Reduction of medication after 6 months, %	28.3 (n = 17)	31.7 (n = 19)	8.3 (n = 5)	31.7 (n = 19)
	Grade 1	Grade 2–3	Grade 4–5	
Personal satisfaction after 6 months, no.*	17	24	19	

* Grade 1, total relief; grade 2–3, considerable improvement; grade 4, minimal; grade 5, no improvement.

an essential improvement of their headaches during the first month postoperatively, this favorable result unfortunately did not last. For the first time in years, they had experienced a migraine-free period that had lasted between 4 and 12 weeks postoperatively. Naturally, their disappointment was extreme when their complaints gradually returned, in the majority of cases after 4 to 6 weeks.

As all of them had been operated on by the same surgeon using the same technique, the question arose, what might be the reason for the recurrence of their headaches: remaining muscle fibers causing pressure on the nerve, or scarring?

One patient (F.A.) decided to undergo an operative revision. A secondary neurolysis of the supratrochlear nerve was attempted, but it proved to be extremely difficult and ended in the transection of the nerve at one side. No relief at all could be achieved.

Analysis of these 11 patients showed that eight of them were from preoperative group C and had a severe form of migraine or “permanent headaches.” Five of them were considered to be drug addicted. This accentuates our experience that these patients have a far worse chance for relief of their headaches and that

one has to wait at least 3 months postoperatively before one can call the result permanent.

Difference in the grade of satisfaction between the 1 and 6 months postoperatively. At 1 month, 86.7 percent of patients showed a successful response to the operation. This initial favorable response dropped to the final result of 68.3 percent with a successful operation (Table IV).

Drug reduction (triptanes). Of the 24 patients who reported grade 2 or 3 personal satisfaction, this was not only because of a reduction in the number of headaches days but also because of an essential reduction in the amount of drugs necessary to suppress the migraine. Especially striking was that many of them stated that they did not need triptanes anymore but were able to suppress their headaches with aspirin or low amounts of specific migraine drugs.

Analysis of these 24 patients showed that before the surgery 12 used to take triptanes alone, triptanes in combination with ergotamine, or other nonspecific drugs (patients 2, 7, 12, 15, 23, 26, 27, 28, 31, 36, 39, and 56). Of these 12 patients, seven (patients 2, 26, 27, 28, 36, 39, and 56) were free of the need for triptanes after the surgery. For these patients, this was a substantial improvement in their medical expenses, as one pack of triptanes (six tablets) in Austria costs about \$100. Considering that the average monthly income in Austria is about \$1200, one can imagine that a migraine patient quite easily may need to spend 10 to 20 percent of his or her salary just for drugs.

TABLE III
Grade of Satisfaction

	Grade 1	Grade 2–3	Grade 4–5
Satisfaction, by age			
Age < 60 years (n = 39)	12 (30.8%)	15 (38.5%)	12 (30.8%)
Age > 60 years (n = 21)	5 (23.8%)	9 (42.8%)	7 (33.3%)
Satisfaction, by migraine severity*			
Group A (n = 9)	2 (22%)	6 (67%)	1 (11%)
Group B (n = 24)	10 (41.7%)	8 (33.3%)	6 (25%)
Group C (n = 27)	5 (18.5%)	10 (37%)	12 (44.4%)

* Group A, 1 to 4 days of migraine per month; group B, 5 to 14 days of migraine per month; group C, more than 15 days of migraine per month.

TABLE IV

Difference in Grade of Satisfaction after 1 and 6 Months

	Grade 1	Grade 2–3	Grade 4–5
1 Month	28 (46.7%)	24 (40%)	8 (13.3%)
6 Months	17 (28.3%)	24 (40%)	19 (31.7%)

Provocation of migraine by trigger compression.

Two patients reported a remarkable phenomenon: the arousal of an acute migraine attack after accidental compression of the trigger zone. In one patient, we had marked the course of the supratrochlear nerve by painting a corresponding line on the skin, to explain it to other patients. As this had been done with a strongly adherent ink, quite heavy pressure and rubbing were necessary to remove the line. Thus the patient involuntarily massaged the underlying nerve. The patient, who had been free of any migraine for 2 months, called about 1 hour later and reported that she experienced a severe migraine attack, like those she had experienced before the operation.

Another patient told us a similar story. Someone recommended that he softly massage the scars at the upper eyelid to get them to mature faster, and anytime he did this, he also experienced some kind of mild migraine. These reports conform the suspicion that compression of the supratrochlear nerve might play an essential role in provoking a migraine attack.

After the first report by Guyuron et al.,¹ our expectations for this new migraine treatment were high. Almost 2 years later and after more than 100 patients have been operated on (the first 60 are included in this report), we are convinced that this operation is of real value and will become an essential tool in the treatment of this widespread malady. Because of the large number of people who are affected by migraines, this treatment has essential social and economic effects. A reduction in the number of headache days means that people will be able to stay on their jobs and get back their pleasure in their private and social lives.

We had to realize that it is not easy to convince our colleagues, especially neurologists, that we have “accidentally” found a good method for the treatment of this malaise. We agree that there is good reason to distrust reports of 80 percent cure rates. We still believe that migraine is a neurological disease and that it needs to be treated primarily by neurologists,

but plastic surgeons may become important helpers for those patients who do not get substantial relief of their headaches after thorough neurological treatment. We believe that we do have a tool, but we still do not know why and how it works; this naturally leaves some scientific disappointment.

Our observations confirm the opinion that the corrugator muscle has a “trigger function,” and that the compression of the supratrochlear nerve is essential for the provocation of a migraine attack. Our data show that there is a distinct difference in the chance of responding positively to the operation: the milder the migraine headaches are, with regard to frequency, duration, and amount of drugs needed to suppress them, the better the chances of improvement.

Since the operation has so far not caused any serious complications or side effects, it can be recommended to patients with severe forms of migraine and symptoms of drug dependency. These patients still have a 50 percent chance of responding with partial or even total relief of their headaches.

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