

## Corrugator supercilii transection for headache emanating from the frontal region: a clinical evaluation of ten patients

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**Abstract** Chronic daily headache (CDH) located in the frontal region is a common problem. We have previously described the positive results that were achieved with botulinum toxin (BTX) injections in the musculus corrugator supercilii (MCS) for this disorder. Nowadays, we offer transection of this muscle to patients following a minimum of two BTX injections, provided these injections result in a significant reduction of pain. This procedure is based on the assumption that the pathophysiological mechanism in some of these patients suffering from CDH is a neural entrapment of the supratrochlear nerve in the corrugator muscle. To assess the effect of transection, we have evaluated all the consecutive patients ( $n = 10$ ) so far. Treatment was successful in nine of these patients. Prior to the treatment, the mean pain score in the 9 successfully treated patients was 8.1 (range 6–9), after transection this had been reduced to 0.8 (range 0–3). All of these successfully treated patients ceased their daily use of pain relief medication for their frontally localised headaches. Moreover, they stated that they would definitely undergo surgery, if they were to find themselves in the same situation again. Therefore, we conclude that transection of the MCS is an efficient and successful procedure for a

carefully selected group of patients suffering from CDH in the frontal region. Most of all we intend to popularise this pathophysiological concept based on the distinct possibility that some headaches might be due to neural entrapment.

**Keywords** Musculus corrugator supercilii · Surgery · Chronic tension type headache · Chronic daily headache · Botox

### Introduction

Approximately 4% of the population worldwide experiences daily or near-daily headaches. The term chronic daily headache (CDH) refers to frequently occurring headaches ( $\geq 15$  days per month) that are not related to structural or systemic illness. CDH is the most common problem seen in Tertiary Headache Centres. The term encompasses chronic migraine, chronic tension type headache (CTTH) and medication-overuse headache. For this condition, no drug has proven ideal due to the inadequate efficacy and intolerable side effects (Dodick et al. 2005; Mathew et al. 2008; Silberstein et al. 2005; Silberstein 2005).

It is an anatomical fact that the supratrochlear nerve (SN) runs through the musculus corrugator supercilii (MCS). Although neural entrapment in muscles is a well-known cause for neuropathies (pronator teres syndrome, piriformis syndrome), this concept is still largely unknown for headache. We propose a pathophysiological concept for a subpopulation of patients with CDH/CTTH in the frontal region, namely, a neural entrapment of the SN in the MCS. This is based on the fact that MCS transection provides a significant relief of headaches emanating from or localizing to the frontal and glabellar regions (Bearden and Anderson 2005).

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In order to confirm the possible use of botulinum toxin type A (BTX) as a diagnostic step before the mentioned transection, we injected BTX into the MCS. We were hopeful that this would enable us to clearly distinguish the patients that might benefit from MCS transection (De Ru and Buwalda 2009). In this article we describe the results of MCS transection, specifically focussing on those patients who prior to surgery had at least twice enjoyed significant pain relief of their frontally located CDH following a BTX injection.

## Patients and methods

This article describes an evaluation of our clinical practice; therefore no ethics approval was requested.

All the patients fulfilled criteria for CDH/CTTH (with or without medication overuse). They experienced daily, bilateral pain of a pressing/tightening quality and moderate intensity. All the patients complained of the same sort of pain emanating from or localizing to the frontal and glabellar region. Most of them used a lot of pain relief medication (see Table 1). The pain was mostly attributed to the paranasal sinus and this was the reason for visiting a

Tertiary ENT clinic. Half of the patients had been operated upon before, because of the (suspected) nasal/sinus pathology (see Table 1). However, we found no signs of sinus disease or other pathology as possible causes for the pain in the frontal region that these patients experienced.

Only those patients with a frontally localised daily headache, whose pain worsened with pressure on the orbital rim near the SN, and who had subsequent reduction of pain after an anaesthetic nerve block were selected. These patients received BTX (approximately 12.5 IU Botox®) injections into the MCS on both the sides (De Ru and Buwalda 2009). BTX was injected into the MCS on each side, using a 25 gauge needle, in 5 steps of 0.1 ml, adding up to a total of approximately 25 IU BTX in 1 ml of NaCl 0.9 solution. Four patients in the present evaluation were also incorporated in the previous evaluation (De Ru and Buwalda 2009).

All the patients who noticed a significant reduction of the pain—at least decrease to half the initial score—following the injection of BTX, in at least two successful sessions, were offered transection of the MCS. This manuscript describes ten consecutive patients who underwent the surgery according to this treatment protocol. Pain severity scoring was performed in a verbal numerical rating scale (NRS),

**Table 1** Demographic table of the patients that were evaluated

| S  | Age | ths      | NRS | Co-morbidity (relevant) | Pain relief medication bs                                      | NRS fu                                      | fu time (months) | Pain relief medication fu | Again/recommend    |     |
|----|-----|----------|-----|-------------------------|--|---|------------------|---------------------------|--------------------|-----|
|    |     | (months) | bs  |                         |  |   |                  |                           |                    |     |
| 1  | F   | 30       | 36  | 8                       | M. Graves, Orbital decompression, Fess 5 times, neuropathy SON | PCM 500, 6dd Napr. 250, 3dd                 | 0                | 12                        | PCM 500, not daily | Yes |
| 2  | F   | 25       | 96  | 9                       | –  | –   | 2                | 4                         | –                  | Yes |
| 3  | F   | 38       | >60 | 8                       | FESS 6 times<br>Septoplasty<br>Asthma                          | Pregab. 25, 3dd                             | 0                | 18                        | –                  | Yes |
| 4  | F   | 40       | >24 | 8                       | Nasal surgery 7 times  | Ibu. 400, 6dd                               | 7                | 4                         | Ibu 400, 6dd       | No  |
| 5  | M   | 18       | 24  | 9                       | –  | PCM 500, 6dd Napr. 250, 3dd<br>Ibu 400, 4dd | 0                | 30                        | –                  | Yes |
| 6  | M   | 28       | >24 | 9                       | –  | PCM 500, 4dd<br>Tram. 50, 4dd               | 0                | 15                        | –                  | Yes |
| 7  | F   | 19       | 84  | 8                       | –  | –   | 0                | 10                        | –                  | Yes |
| 8  | M   | 57       | 120 | 9                       | FESS 2 times<br>Asthma<br>OSAS                                 | PCM/Cod 500/10, 5dd                         | 2                | 7                         | –                  | Yes |
| 9  | F   | 32       | 120 | 6                       | Migraine   | Topi. 10, 3dd<br>Sumatr. occ.               | 3                | 3                         | Sumatr. occ.       | Yes |
| 10 | F   | 20       | 120 | 7                       | FESS 2 times   | Ibu. 400, 4dd                               | 0                | 10                        | –                  | Yes |

S sex, ths time before surgery, NRS numerical rating scale score of the pain, FESS functional endoscopic sinus surgery, SON supra-orbital nerve, OSAS obstructive sleep apnea syndrome, PCM paracetamol, Napr. naproxen, Pregab. pregabalin, Ibu. ibuprofen, Tram. tramadol, Cod codeine, Topi. topiramate, Sumatr. sumatriptan, occ. occasionally, fu follow up

ranging from 0 (no pain) to 10 (severe pain). Patients were also questioned about their use of pain relief medication.

The transection was performed by means of an endoscopic brow lift procedure, performed by two different specialists at two different hospitals (PS and PL). In this procedure surgeons make three small incisions (ports) placed high on the forehead above the hairline. Tunnelling is performed in the subperiosteal plane. Next the periosteum is incised at the orbital rim. Then cleavage of the MCS is performed. For detailed anatomy we like to refer to the excellent article by Janis et al. (2008).

## Results

For a patient description see Table 1. These are the first ten consecutive patients that were operated upon. Nine patients (90%) had a drastically lowered pain score post-operatively. Mean score of these nine patients prior to surgery was 8.1 (range 6–9). Post-operatively, their pain score was 0.8 (range 0–3). Patients were scheduled to visit our outpatient clinic approximately 1 month after the surgery. All stated that the frontal headache disappeared/diminished immediately after the surgery.

For reporting purposes of this manuscript the effectiveness was re-assessed by means of a telephone interview. The follow-up time ranged from 3 to 30 months. Pain relief was suggested to be permanent at 3 months (Dirnberger and Becker 2004). All the nine successfully treated patients ceased using pain-relieving medication, such as paracetamol and NSAIDs on a daily base.

Our patients mentioned some adverse effects of the surgery, including numbness in three patients, and paresthesia and haematoma formation in one case. Three patients found the procedure to be more uncomfortable than they had expected. However, in retrospect, all the nine patients stated that they would undergo surgery again if they were to have to make the choice again.

All the successfully treated patients also stated that they would recommend this therapy to other patients suffering from the same problem—two have already recommended this therapy to colleagues.

Unfortunately, one of our patients was unsuccessfully treated. Her pain score was eight before surgery and still seven at five months follow-up, post-operatively. She still uses ibuprofen six times daily, which is the dosage she used pre-operatively.

## Discussion

Injection of BTX into cranial muscles as a treatment for headaches, migraines especially, is a much-debated form of

therapy, as the pathophysiology still is not well understood (Evers and Olesen 2006; Roach 2008). However, we have used this therapy with great success for CDH/CTTH in the frontal region. The precise mechanism is open to discussion, but we, like others, hypothesize that a neural entrapment of the SN, which passes through the MCS, may be the cause of headaches in some of these patients (Guyuron et al. 2000). Consequently, this entrapment is resolved by transection of the muscle.

In our evaluation, MCS transection indeed has proven to be a very effective treatment if performed following the successful initial injections with BTX. The frontally located headache diminished drastically in 90% of our patients. We have established an easy-to-use algorithm for this form of treatment: if the headache is described as a frontally localised pain—and patients experience aggravation of the pain with pressure on the orbital rim at the site of the SN—and a subsequent reduction of pain after an anaesthetic nerve block—and reduction of pain following injection of BTX in the MCS—then a transection of the MCS is warranted.

Remarkably, in our patient who did not enjoy any improvement of her condition; the pain had initially been absent during the first 10 days following the surgery, only to resurface shortly thereafter. Two months later, this patient was again treated successfully with a BTX injection. If our proposed theory is correct then the BTX would not offer any pain relief if injected into a transected muscle. We therefore have no clear explanation for this result. It is possible that the muscle was not transected in its entirety, or the muscle may have regenerated and re-connected. We presume that the lack of success in this patient's situation is due to a surgical failure and we are therefore considering renewed surgery.

A high placebo response is an established confounder in evaluating the (surgical) treatment of painful conditions. Since our study was not a randomised controlled trial (RCT), the effect may have been influenced by many biases. However, there is general agreement that so-called striking effects can be discerned without the need for RCTs (Glasziou et al. 2007; Rawlins 2008). A large signal-to-noise ratio (rate ratio beyond 10) is strongly suggestive of a genuine therapeutic effect. Furthermore, there is no appropriate treatment available to be used as a control, and for those patients who do not receive treatment the prognosis is poor (predictable natural history). There are no substantial side effects that would compromise the potential benefit of this therapy. Moreover, the treatment has a biologically plausible basis. Finally, the results are consistent for the two surgeons at different hospitals.

When we calculate the rate ratio in our group for the patient with the longest and the patient with the shortest follow-up time, this would be:  $(1/1)/(0.5/730) = 1,471$

(730 days without improvement versus total improvement within one day) and  $(0.5/1)/(0.5/3,600) = 3,597$  (10 years without improvement vs. reducing the severity score to half of the original pain score in one day). This clearly constitutes a genuine effect (Glasziou et al. 2007).

The clinical impact is such that effective and tolerable treatments are clearly needed. MCS transection has few adverse effects, and could therefore be a popular therapeutic option for many patients, provided that the selection procedures are followed correctly.

In light of the impact of CDH on society as a whole, every doctor who regularly sees patients suffering from headaches should, in our opinion, be familiar with the above-mentioned algorithm. We propose that this form of treatment could not only potentially offset substantial costs in terms of healthcare, but it could also have a significant effect on the loss of and/or diminished productivity due to daily headaches.

Neural entrapment/compression is mentioned as an etiologic factor in many different neuropathies. This entrapment/compression can be caused, e.g. on a microvascular level—intracranially—in case of Trigeminal Neuralgia, by ligaments/fascia in suprascapular entrapment and meralgia paraesthetica, or by muscles as mentioned previously. We would like to propose neural entrapment as one of the possible causes of frontally located CDH/CTTH as well.

If accepted, the neural entrapment/compression theory as pathophysiological concept for headaches, may lead to the possible future surgical treatment of other types of headaches as well. Possibly, this might lead to the surgical procedures to relieve the entrapped nerves that cause these headaches, as has previously been suggested by others (Guyuron et al. 2002).

*Post scriptum* The one patient who was unsuccessful at first stage has been painfree since the second procedure which was performed more than three months ago now. She stopped taking ibuprofen completely ever since. Furthermore, with another 12 months after the first telephone interview—the time from evaluation to publication—none of the successfully operated patients has returned because of recurrence of the headache, although they were instructed to please contact if the pain would re-appear. This would lengthen the follow-up from 15 to 42 months for these patients.

## Conclusion

We conclude that corrugator supercilii transection is a highly effective treatment for carefully selected patients with CDH/CTTH emanating from the frontal region, and neural entrapment of the SN may be the cause of this pain.

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