European Journal of Neurology 2010, **17** (Suppl. 1): 107–112 doi:10.1111/j.1468-1331.2010.03061.x

Physiotherapy of focal dystonia: a physiotherapist's personal experience

J.-P. Bleton

Université Paris Descartes INSERM U894, Service de Neurologie, Hôpital Sainte-Anne, Paris, France

Keywords:
dystonia, physiotherapy, cervical dystonia, writer's cramp, writing tremor, relaxation, pen grip training

Received 3 August 2009
Accepted 5 March 2010

The approach of the physiotherapist to each form of dystonia is individual and has to be specific. There is not one single method but several strategies related to the different clinical forms. Although there is no standard programme applicable to all forms of cervical dystonia, we can distinguish a number of guidelines for the different clinical forms. In the myoclonic form, emphasis is placed on seeking to immobilize the head, and for the tonic form, on rehabilitating corrector muscles. Physiotherapy and botulinum toxin injections mutually interact in order to reduce the symptoms. Recent studies have shown the clinical benefits of physiotherapy. The physiotherapy of writer's cramp is designed as a re-learning process. The first step is to perform exercises to improve independence and precision of fingers and wrist movements. Then, the muscles involved in the correction of dystonic postures are trained by drawing loops, curves and arabesques. The aim of rehabilitation is not to enable patients with writer's cramp to write as they used to, but to help their dysgraphia evolve towards a fast, fluid and effortless handwriting. A reshaping of the sensory cortical hand representation appears to be associated with clinical improvement in patients with dystonia after rehabilitation.

The usual treatment for pathologies affecting motor function involves physiotherapy, thereby explaining why physiotherapy has always played an important role in the treatment of dystonia and why specialized exercises have been prescribed by neurologists such as Duchenne (de Boulogne) [1], Oppenheim, Brissaud and Meige [2]. Nowadays this therapy, which is now well developed and structured, aims to give patients as much independence as possible, in a palliative or healing way. The choice of therapy will be often guided by personal experience or results of open-labelled trials. Presently, focal and segmental dystonia are more likely to be treated with local therapy (botulinum toxin injections and physiotherapy). The most frequent forms of dystonia treated with physiotherapy are cervical dystonia and occupational dystonia such as writer's cramp. Despite few controlled studies regarding the use of rehabilitation for these pathologies, there is a wide consensus of the medical profession, and physiotherapy is currently proposed to complement botulinum toxin injections [3]. As the possibility of voluntarily modifying the severity of the dystonic activity has been demonstrated with visual and auditory feedback [4,5], physiotherapy is currently undertaken individually or in combination with botulinum toxin injections. There is not one single method but different strategies related to the different clinical presentations. The exercise programmes are selected taking into account the pathophysiology and case studies. Dystonic movement reveals excessive co-contraction between agonist and antagonist muscles. Rather than calling on synergistic muscles to carry out a movement, patients involve dystonic muscles that disturb the correct execution of the movements. Amongst the elements of pathophysiology relevant to the development of rehabilitation programmes, the loss of inhibition seems to play the main role. The rehabilitation programme tries to focus selectively on the underperforming muscles and not create an overflow onto other muscles.

Correspondence: J.-P. Bleton, Department of Neurology, Physiotherapy Unit, Sainte-Anne Hospital, 1, rue Cabanis, F-75014, Paris, France (tel.: +33 145 65 85 05; fax: +33 145 65 74 57; e-mail: jp.bleton@ch-sainte-anne.fr).

Cervical dystonia

Physiotherapy is frequently prescribed in association with botulinum toxin injections [6] and systematically proposed after surgery (peripheral selective denervation) [7]. Despite there being a great deal of similarity between the different forms of cervical dystonia, each

case is unique and requires its own tailored rehabilitation programme based on clinical evaluation. Assessment of the different pathological elements guides rehabilitation. The patients treated with physiotherapy in the rehabilitation unit were referred from different hospitals by neurologists specialized in movement disorders. They underwent an initial assessment and repeated assessments were carried out throughout the treatment period. The assessment included objective measures of active range of motion, identification of the dystonic muscles involved, a scale of severity of cervical dystonia, a global clinical evaluation and a subject-rated self-assessment. Patients were evaluated in the same way whether or not they received botulinum toxin injections [8].

When possible, physiotherapy assessment is performed before the botulinum toxin injections have modified the clinical presentation [9]. The physiotherapy method varies according to whether the cervical dystonia is caused by the repetitive (myoclonic), or constant (tonic) pathological contraction of one or more cervical muscles. The muscles recognized as responsible for pathological posture are stretched and relaxed. These antagonist muscles are the focus of the rehabilitation plan.

Classically, the steps to follow are stated below:

- to stop abnormal movements by specific relaxation techniques;
- to reinforce the corrective muscles by bringing about the head to the opposite side to the torticollis attitude;
- to avoid muscular overflow and co-contractions by precise and analytic activation of the corrective muscles;
- then, to replace spasms by voluntary and adapted movements of the head [10].

Although there is no standard programme applicable to all forms of cervical dystonia, we can distinguish a number of guidelines for the different clinical forms. In the myoclonic form, emphasis is placed on immobilizing the head, and in the tonic form, on rehabilitating corrective muscles.

Reducing pathological head movement is a principal aim for the myoclonic form. The rehabilitation programme attempts to achieve muscle relaxation and hence near-total head immobility. The position of the eyes plays an important role. Directing the line of sight to the side opposite to the torticollis reduces the spasm and promotes correction of the cervical dystonia. Controlled immobility is repeated several times a day, in front of a mirror to allow self-monitoring. The stabilizing role of the deep cervical muscles, particularly the semispinalis muscles, must be developed.

The need to reinforce the activity of the muscles correcting the cervical dystonia is more appropriate for tonic forms. From the physiotherapist's point of view, cervical dystonia presents itself as the functional inability to activate and maintain the muscle synergies required to carry out correct movements. They may combine with each other. The head is placed in the opposite position to the dystonic posture (Figs 1 and 2), to contract the corrective muscles, whilst avoiding increasing tonic resistance (shortening reaction or Westphal's phenomenon) [11] and preventing diffusion (overflow) [8]. Deformities vary according to the dystonic muscles and their distribution. The physiotherapy programme tries to focus selectively on the inactive muscles and not to overflow onto other muscles. The supine position, with the torso slightly raised, permits muscle relaxation, allowing for easier voluntary contraction of corrective muscles. At a more advanced stage, the rehabilitation of deficient muscles and the search for postural adjustments are carried out whilst sitting and in front of a mirror for dual monitoring by the therapist and the dystonic patient. Progression continues to monitoring whilst standing and finally when walking.

Some patients complain of pain or muscular tension [12] either in the muscle itself or at its insertions on the clavicle, the scapulae or the spine. The painful muscles can be dystonic or compensatory. Muscle relaxation is

Figure 1 Retrocollis: clinical presentation.

Figure 2 Retrocollis: active control.

obtained by local stretching, adapted head placement, eventually with ultrasound, heat packs or hydrotherapy.

Patients are encouraged to correct the pathological posture at all times by organizing their activities of daily living in such a way as to hold their heads on the opposite side to the deformation. They are encouraged to be active and practise sports such as walking, swimming, tai chi or yoga [13].

Motor education, along with the specific rehabilitation of corrector muscles, allows a functional balance to be struck between dystonic muscles that have been weakened by injections and corrective muscles strengthened by the exercises.

Writer's cramp

If the protocol of physiotherapy for cervical dystonia seems well established, this is not true for writer's cramp. Writer's cramp is a dysgraphia acquired during adulthood, classified in the nosologic group of occupational dystonia. These dystonias have in common an excessive repeated overuse of an instrument or a tool [14]. Like all other forms of dystonia, writer's cramp is characterized by abnormal and involuntary contractions of the muscles of a part of the body, in this specific case, the hand and the fingers. Contrary to other dystonia, the abnormal muscular contractions appear only during the task of handwriting. Botulinum toxin injections now have their place in therapy [15]. Encouraging results have been obtained when the graphospasm is localized to one or two muscles. The choice of the sites and the dose of injections are difficult to establish in order to keep the hand functional. These difficulties have opened the way to modern concepts of physiotherapy. Nevertheless, the idea that writer's cramp warrants rehabilitative treatment has existed since the middle of the 19th century. During the seventies, various studies relating to the use of biofeedback showed the possibility of decreasing the severity of the graphospasm by will. The modern physiotherapy of writer's cramp is designed as a re-learning process. Its aim is not to enable patients with writer's cramp to write as they used to, but to help their dysgraphia to evolve towards a more relaxed, more flexible and controlled movement.

The clinical examination of writer's cramp is not perfectly standardized. Nevertheless, a few points must be evaluated: the context of apparition, the influence of the environment upon handwriting, movement and posture, the writing itself and the socio-professional impact. The description of the first symptoms such as the location of muscular spasms or pains compared to physical examination, as well as the variations of the abnormal posture with different ways of holding of the pen, allow differentiation of the dystonic abnormalities and the postural compensations. Cursive handwriting is assessed during the reproduction of a text, the writing of a short letter with signature and a short sentence written as many times as possible in 1 minute. The handwriting volume, speed and legibility are analysed. The posture of the trunk and head, the effect of the paper position upon this posture, the position of the different segments of the upper limb and the use of the pen are studied. The presence of a tremor or a particular difficulty in tracing letters in the clockwise or anti-clockwise directions is checked.

The best results are obtained with a rehabilitative strategy leading to a clear modification of the handwriting technique, in order to break down the abnormal motor programme. A noticeable improvement is obtained, as suggested by Meige [9], by writing 'a little bit, slowly, large, straight and circular'. At the beginning of rehabilitation, some advice is useful to diminish the precipitating factors of writer's cramp. The patient is asked to reduce the amount of handwriting but not to stop completely; lessen the pressure upon the pen, using a long pen with a smooth point (heavy pens can also lessen a writing tremor); control the speed of writing and resist the desire to complete the exercises quickly; avoid anxiety when writing whilst observed by another person; respect the fatigue and stop writing to relax the limb when necessary, before muscular contractions and pain appear.

Before rehabilitation of the writing task, it is important to make the upper limb muscles supple and relaxed, including the shoulder girdle and, sometimes,

the neck. Muscular tension and pain are associated with the concept of 'starter muscles'. Once the muscles particularly related to the triggering of dystonia are identified, they are the targets of myorelaxing techniques (stretching, corrective postures) in order to neutralize their excessive pathological activity and to break down the dystonic attitude. Passive movements are performed in order to maintain a physiological range of motion of the upper limb joints necessary for handwriting. Stretching is frequently performed on supination of the forearm, extension of the wrist and fingers, opposition of the thumb, abduction and external rotation of the shoulder. The feeling of liberty offered by these motions provides a deep sensation of relaxation in the whole upper limb. Muscle relaxation has shown to be a useful technique in helping patients to develop an acute awareness of muscle tension states and to learn to control the effects of tension on the dystonic muscles themselves. Specific relaxation methods for stress reduction can be added in patients who suffer from excessive anxiety towards their difficulties in handwriting. At the beginning of the rehabilitation schedule, Jacobson's progressive muscle relaxation leads to a passive progressive muscular relaxation (sensation of 'dead arm') [16]. Then, Schultz's autogenic training allows an active state of muscular relaxation (sensation of 'heavy arm'). This sensation of 'heavy arm' will be looked for throughout the rehabilitation whilst relaxing, performing graphomotor exercises and writing [17].

The next step of the physiotherapy programme is to improve independence and precision of fingers and wrist movements. The muscular groups that correct the abnormal posture are underperforming. They are trained by tailored exercises [18]. The exercises are performed without any link to handwriting. Active movements of flexion and extension associated with pronation and supination are repeated in the forearm and wrist. Finger dexterity is trained by specific gymnastics [19]. These contractions must be precise and controlled enough to provide overflow to the dystonic muscles. These exercises prepare the patient to use the necessary muscles involved in drawing and writing. Special care must be taken of the wrist because of its predominant implication in the cursive movement. When the wrist is too rigid, the patients often compensate with the shoulder, gripping the fingers and blocking the distal articulations of the limb. Between two rehabilitation sessions, the hand must not remain inactive and the patient is asked to perform fine manipulation and dexterity training several times a day.

Then, the muscles involved in the correction of dystonic postures are trained by drawing vertical lines, arches, cups, loops, sinusoids and arabesques [20]. The aim is not to keep the dystonic muscles inactive nor to write against pain and contracture, but to learn a new means of writing. The habit of an abnormal grip of the pen is difficult to overcome. The ergonomic and corrective way of holding the pen is shown, explained, corrected and repeated with exercises. The pen must be placed between the thumb's and the forefinger's pads and contact the lateral face of the middle finger.

Handwriting is introduced when the preparatory exercises are performed at sufficient speed, without contractions or haste. The new sensations felt by the patient are used to improve the movement of the pen upon the paper. The progression consists of switching from cursive controlled handwriting to a more fluid and personal handwriting in a way of finally obtaining the fast handwriting the patient needs in daily living. This short stop is performed slowly to avoid dystonic contractions. The speed of writing is important. Speeding up the movement can cause a reduction in size and irregularity of the letters. Slowness is responsible for excessive pressure on the pen, lack of precision and, sometimes, tremor. When controlling handwriting, the patient becomes overly conscious of the act [21], whereas normal handwriting should remain automatic.

Frequently, a tremor associated with the dystonic hand posture occurs in the course of the writing task. Sometimes it occurs when muscle contraction decreases; this tremor can thus mean improvement. In other patients, pure writing tremor, previously neutralized by the excessive muscular contractions, can become obvious. The tremor can appear when starting to write or during the course of the writing task. Physiotherapy is usually harder in the cases of writing tremor. So, the aim is not to reduce the tremor but to train the patient to write in a way in which the tremor is minimal. Relaxation is an efficient means of controlling body and gestures [22]. This implies a certain degree of attention. The physiotherapist encourages a 'quiet attention' instead of 'tensed attention'. Finger exercises and stretching of the muscles recognized as responsible for the tremor, as well as a comfortable posture of the hand on the table, can reduce the severity of the writing tremor.

When the tremor is localized to the fingers holding the pen, one way is to modify the classical pen grip and hold the pen between the first and the fourth interosseous spaces. This way of holding the pen as a dagger prevents any contact between the pad of the fingers and the body of the pen and therefore often abolishes the tremor completely and allows rapid and fluid handwriting [23].

Results of physiotherapy

Frequently, help and comfort are gained with physiotherapy of cervical dystonia. The works of Pierre Rondot have shown the effectiveness of physiotherapy

when combined with medical drug treatment and injections [24]. At this time (before the introduction of the botulinum toxin), using this combination, about 70% of patients benefited from physiotherapy, with mild to dramatic improvements. Nowadays, with the introduction of botulinum toxin, it is more difficult to estimate the positive benefits of physiotherapy for cervical dystonia. Botulinum toxin injections and physiotherapy mutually interact in order to reduce the symptoms. Some recent studies have confirmed the benefits of the combination of physiotherapy and botulinum toxin injections. The study by Tassorelli C and contributors showed a longer duration of the clinical benefits of botulinum toxin injections, a lower dose at re-injection and a reduction in the disability of daily living and subjective pain scores [25]. In our rehabilitation unit, 1106 patients were treated by physiotherapy for cervical dystonia since 1984. A good result needs constant effort and can take from 6 to 12 months (sometimes more) of daily personal practice. About 20–40 weekly sessions were necessary. A prospective randomized, controlled study evaluating the efficacy of this particular type of physiotherapy is currently in progress.

All of the physiotherapy exercise programmes for writer's cramp are individualized. The sessions are individual, allowing a face-to-face contact between the physiotherapist and the patient. Sessions must not last too long to prevent discomfort and tiredness. Between 30 and 45 min is a suitable duration, and the sessions end with myorelaxation exercises. The frequency of sessions is once or twice fortnightly according to the clinical presentation and the availability of the patient. The patient is asked to perform the specific exercises at home. In our rehabilitation unit, 838 patients with writer's cramp were treated by physiotherapy since 1993. From experience, more than 50% of the patients suffering from writer's cramp obtain a fast, fluid and effortless handwriting. But a clear and clinical improvement takes a long time. The results from a sample of 38 patients receiving treatment in the same year demonstrate 42% with mild improvement or no change versus 57% who had good or excellent results following this type of physiotherapy treatment. In general, 6–12 sessions are necessary, with an individualized, progressive exercise program to be carried out by the patient between sessions. A deep modification of the 'new' handwriting requires from 3 to 6 months, or sometimes even longer (Fig. 3). When rehabilitation is not a success, a device such as a computer, a writing splint or assistive device for writing or changing hands may be useful [26]. Recent studies have confirmed the efficiency of certain physiotherapy approaches such as a modified pen grip [27], sensory training [28] and EMG biofeedback [29]. A reshaping of the sensory cortical

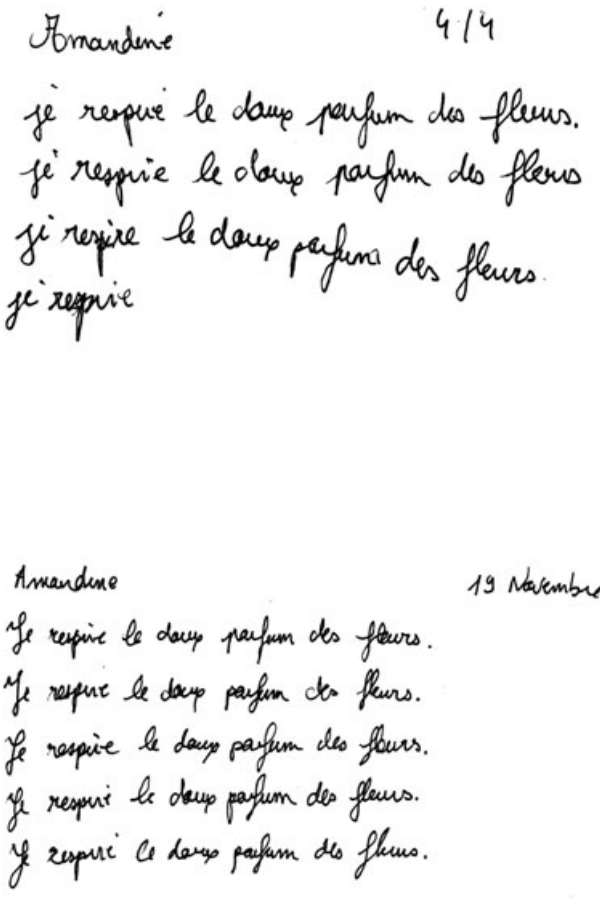

Figure 3 Example of corrected handwriting following rehabilitation.

hand representation appears to be associated with clinical improvements in patients with dystonia after rehabilitation. Meunier S. and contributors [30,31] using a magneto-encephalography scanner showed that behavioural training and tailored physiotherapy produce a reorganization of the map of the fingers on the cortex of the dominant hemisphere [32]. These preliminary results are encouraging and advocate proposing physiotherapy to patients suffering from writer's cramp and occupational dystonia. A retrospective study of a large population of patients treated in the rehabilitation unit in the past 10 years is currently being undertaken.

Acknowledgements

Simone Birnbaum for her assistance in proofreading.

Conflicts of interest

There are no conflicts of interest; no funding was received for this article.

References

1. Duchenne de Boulogne GB. *De l'électrisation localisée et son application à la pathologie et à la thérapeutique*. Paris: Baillière et fils, 1862.
2. Brissaud E, Meige H. *La discipline psycho-motrice (Congrès de Madrid)*. Paris: Archives générales de médecine Avril, 1903.
3. Marion MH. Treatment of dystonias. *Presse Med* 1999; **28:** 312–315.
4. Korein J, Brudny J. Integrated EMG feedback in the management of spasmodic torticollis and focal dystonia: a prospective study of 80 patients. *Res Publ Assoc Res Nerv Ment Dis* 1976; **55:** 385–426.
5. Pieters G, Cosyns P. Emploi du biofeedback dans le traitement du torticolis spasmodique par psychothérapie comportementale. *Acta Psychiatr Belg* 1981; **81:** 321–334.
6. Jedynak A, de Saint Victor JF. Treatment of spasmodic torticollis by local injections of botulinum toxin. *Rev Neurol* 1990; **146:** 440–443.
7. Bleton JP. Physiotherapy for spasmodic torticollis. In: Bouvier G, de Soultrait F, Molina-Negro P eds. *Spasmodic Torticollis. Clinical Aspects and Treatment*. Paris: Expressions Santé, 2006: 179–197.
8. Bleton JP. *Role of the physiotherapist*. In: Warner TT, Bressman S eds. *Clinical Diagnosis and management of Dystonia*. London: Informa Healthcare, 2007: 223–232.
9. Gelb DJ, Yoshimura DM, Olney RK, *et al*. Changes in pattern of muscle activity following botulinum toxin injections for torticollis. *Ann Neurol* 1991; **29:** 370–376.
10. Meige H, Feindel E. Traitement des tics. Traitement par l'immobilisation des mouvements et les mouvements d'immobilisation. Méthode de Brissaud. *Presse médicale* 1901; **22:** 125.
11. Westphal CFO. Uber eine dem Bilde der cerebrospinalen grauen Degeneration ähnliche Erkrankung des centrlen Nervensystems ohne anatomisschen Befund, nebst einigen Bemerkungen über paradoxe Contraction. *Arch Psychiatr Nervenkr* 1883; **14:** 87–95.
12. Kutvonen O, Dastidar P, Nurmikko T. Pain in spasmodic torticollis. *Pain* 1997; **69:** 279–286.
13. Bleton JP. *Spasmodic Torticollis. Handbook of Rehabilitative Physiotherapy*. Paris: Frison-Roche, 1994.
14. Tubiana R. *Functional Disorders in Musicians*. Paris: Elsevier, 2001.
15. Vidailhet M, Perkinden P, Gallouedec G, *et al*. Les dystonies du membre supérieur: analyse sémiologique et prise en charge thérapeutique. In: Thoumie P, Pradat-Deihl P eds. *La Préhension*. Paris: Springer-Verlag, 2000: 119–126.
16. Zati A, Crémonini P. Le training autogène de Jacobson dans le traitement du torticolis psychogène. *Journal de Réadaptation Médicale* 1993; **13:** 3–6.
17. Ajuriaguerra J(de), Garcia Badaracco J, Trillat E, *et al*. Traitement de la crampe des écrivains par la relaxation. *L'Encéphale* 1956; **2:** 141–171.
18. Bleton JP. *La rééducation de la crampe de l'écrivain*. Marseille: Solal Editeur, 2004.
19. Byl NN, Nagarajan SS, Merzenich MM, *et al*. Correlation of clinical neuromusculoskeletal and central somatosensory performance: variability in controls and patients with severe and mild focal hand dystonia. *Neural Plast* 2002; **9:** 177–203.
20. Denner A. La psycho-motricité en thérapie par l'art. *Psychologie Médicale* 1992; **24:** 1453–1457.
21. Hallet M. Is dystonia a sensory disorder? *Ann Neurol* 1995; **38:** 139–140.
22. Lundervold DA, Belwood MF, Craney JL, Poppen R. Reduction of tremor severity and disability following behavioral relaxation training. *J Behav Ther Exp Psychiatry* 1999; **30:** 119–135.
23. Jedynak CP, Youssov K, Apartis E, *et al*. Dystonia, tremor and repetitive instrumental use. *Rev Neurol* 2008; **164:** 53–60.
24. Rondot P, Marchand MP, Dellatolas G. Spasmodic torticollis: review of 220 patients. *Can J Neurol Sci* 1991; **18:** 143–151.
25. Tassorelli C, Mancini F, Balloni L, *et al*. Botulinum toxin and neuromotor rehabilitation: an integrated approach to idiopathic cervical dystonia. *Mov Disord* 2006; **21:** 2240–2243.
26. Tas N, Karatas GK, Sepici V. Hand orthosis as a writing aid in writer's cramp. *Mov Disord* 2001; **16:** 1185–1189.
27. Dressler D. *Botulinum Toxin Therapy*. Stuttgart, New York: Georg Thieme Verlag, 2000.
28. Zeuner KE, Bara-Jimenez W, Noguchi PS, *et al*. Sensory training for patients with focal hand dystonia. *Ann Neurol* 2002; **51:** 593–598.
29. Cottraux JA, Juenet C, Collet L. The treatment of writer's cramp with multimodal behaviour therapy and biofeedback: a study of 15 cases. *Br J Psychiatry* 1983; **142:** 180–183.
30. Meunier S, Bourdain F, Bleton JP, *et al*. Cortical reorganization after behavioural training in writer's cramp. Poster P06.071, 55th Annual Meeting of the American Academy of Neurology in Honolulu. 2003; March 29–April 5.
31. Meunier S, Garnero L, Ducorps A, *et al*. Human brain mapping in dystonia reveals both endophenotypic traits and adaptive reorganization. *Ann Neurol* 2001; **50:** 521–527.
32. Bleton JP, Vidailhet M, Bourdain F, *et al*. Somatosensory cortical remodeling after rehabilitation and clinical benefit in writer's cramp. *JNNP*. 2010: in press.

