# Focal Hand Dystonia Affecting Musicians. Part II: An Overview Of Current Rehabilitative Treatment Techniques

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**Focal Hand Dystonia is a complex and difficult condition to treat. Many treatment techniques have been trialled with musicians who suffer from this condition. Current treatments include: oral medications, Botulinum toxin (BTX) injections, surgery and rehabilitative therapies. The medical-based treatments have been discussed in a prior paper, and thus rehabilitative therapy treatment options and the related clinical implications are the focus of this paper. These include: sensory re-education, sensory motor retuning, rest, splintage and limb immobilisation. Future research areas relating to focal hand dystonia and the musician are highlighted.**

## INTRODUCTION

Focal hand dystonia occurs in 2-10% of professional musicians and often has devastating consequences for their careers. Treating these patients is difficult and requires, in almost every case, an individual approach. The specific presentation of the dystonic symptoms, personal circumstances such as psychological involvement and professional circumstances (time pressure on recovery due to concert schedule, risk of losing position/job) all need to be considered and must influence therapeutic decisions. There are other pressures that must also be considered. Often the patient's expectations of rehabilitation are unrealistic, in that they are aiming for full recovery so that their performance level is the same as pre-focal hand dystonia onset. Full recovery can only be achieved in certain cases. In most cases, some restriction of motor abilities will remain. Making the most of this situation requires collaboration of several disciplines including the medical profession, music teachers, instrument makers, hand therapists and, on occasion, psychotherapists. The first article outlined the medical treatments for this condition. This article considers the different rehabilitative strategies in detail and the use of a multi-disciplinary team approach.

## REHABILITATIVE THERAPIES

Rehabilitative therapies and supportive approaches for the treatment of focal hand dystonia include:

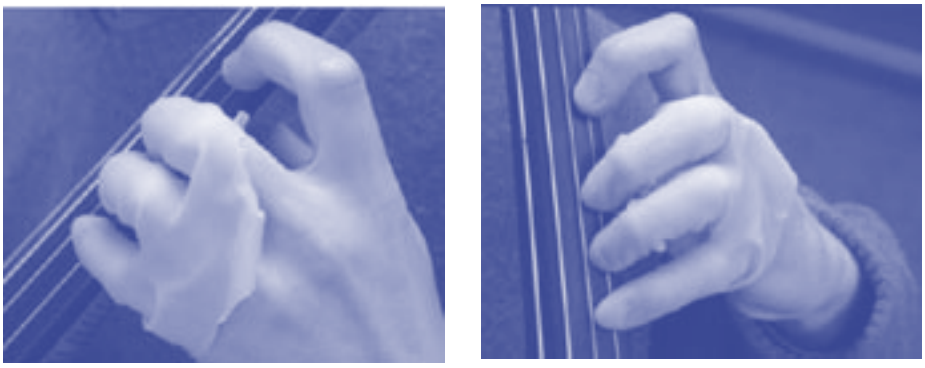
- sensory re-education
- sensory motor retuning (constraint-induced movement therapy)
- rest and splintage
- limb immobilisation
- occupational therapy and physiotherapy
- multi-disciplinary team approach
- assistive devices/modifications to instrument
- Feldenkreis therapy/Alexander technique
- biofeedback therapy
- counselling and psychotherapy.

Research on focal hand dystonia has highlighted a dysfunction of integration of sensory information from the periphery into adequate motor commands in the brain.
This seems to be especially the case in musician's hand dystonia (*Rosenkranz et al 2005*). The aim, when treating a musician affected by focal hand dystonia, is to re-establish integration of sensory proprioceptive afferent and cutaneous information into a controlled, appropriate, adjacent motor command. There are many interlinking techniques that can be employed to assist in achieving this goal. Sensory re-education is a treatment that focuses on sensory discrimination. The treatments that combine both sensory and motor aspects of focal hand dystonia include: sensory motor retuning, rest, splintage, occupational therapy and physiotherapy and the use of a multi-disciplinary approach. Another treatment option is limb immobilisation, which interrupts motor performance and decreases sensory afferents from the limb. Other treatment approaches that can complement the ones above include: assistive devices, instrument modification, Feldenkreis therapy, Alexander technique, biofeedback therapy, counselling and psychotherapy. In order for treatment(s) to have any success, high patient compliance and motivation is required, and associated complications need to be reviewed (ie the musical instrument must be well maintained, and associated medical conditions such as nerve compression or trigger finger{s} must be ruled out).

### SENSORY RE-EDUCATION

The integral role of the somatosensory input is emphasised by the fact that a reduction in involuntary movements and an increase in control can be gained by performing sensory tricks, for example playing the musical instrument whilst wearing a latex glove (*Berardelli et al 1998; Hallett 1995; Lederman 1991*). Recent studies in primates suggest that repetitive motions can induce plasticity changes in the sensory cortex, which may degrade the hand representation and interfere with motor control (*Blake et al 2002; Byl et al 1997, 1996a and b*). Through this research, the possibility of utilising specific sensory training to re-wind

sensory dedifferentiation and therefore successfully treat patients with focal dystonia is raised. Sensory discrimination training is thus emphasised during treatment sessions, and is an integral part of the home exercise programme (*Byl and McKenzie 2000; Byl et al 2000; Byl and Topp 1998*). The same amount of repetition may be needed to restore the hand representation as that which led to its degradation, thus patient compliance is integral to the effectiveness of this treatment (*Byl et al 1996a, b*).



**Figures 1 a and b: Cellist utilising latex glove as a sensory trick**

The sensory discrimination activities include: identifying various textures and temperatures of sensory stimulation on the skin; discriminating and matching coins, beads, buttons and small animal figures; identifying matched pairs of objects in a game or out of a bag of rice, beans or noodles; asking the vision-occluded patient to locate where they are being touched (*Byl and McKenzie 2000*); vibration sensitivity; backward masking; manipulating embossed letters; work on detecting mismatched letters on a keyboard and palpation of directional lines on a cube (*Byl and McKenzie 2000; Byl and Topp 1998*). To facilitate normal sensation and perception and reinforce normal hand functioning, patients are asked to spend time at home meditating, ie visualising healing, imagining normal sensory processing, motor control, and effective target task execution (*Byl et al 2000; Byl and McKenzie 2000; Byl and Topp 1998*).

High patient compliance and commitment is required to perform the number of repetitions of sensory retraining tasks that are necessary to restore the somatosensory function, and in turn improve motor control and stress-free motor movements. It is expected that patients complete at least one to two hours of sensory discrimination activities at home each day (*Byl and McKenzie 2000*).

This treatment approach is supported by a case report of a flautist with focal hand dystonia who displayed changes in cortical topographical representation of the hand, clinical somatosensory discrimination and fine motor control after carrying out a comprehensive rehabilitation programme that emphasised sensory retraining, i.e. specific, repetitive, goal-directed sensory activities (*Byl et al 2000*). Patients with writer's cramp have displayed similar results where, due to continual training through braille reading, a decrease in disability levels and an improvement in spatial discrimination were noted (*Zeuner et al 2002*).

**Figures 2a, b and c: Sensory discrimination activities can include: identifying sensory stimulation, discriminating and matching common household items (a, b) and manipulating embossed items such as dominoes (c).**

## REST AND SPLINTAGE

Rest has been considered a therapeutic approach for the treatment of dystonia for more than 100 years (*Gowers 1893; Poore 1887; Hoppmann 2001*). This treatment approach has limitations for musicians earning their living from playing. If a period of rest can be taken (eg a holiday), it may calm symptoms down, but in any case after a period of not playing, musicians must return with slow graded progression in duration, tempo and complexity of playing, with psychological support (*Tubiana 2000*). (See Appendix 1 for graded return to playing programme) (*Warrington 2003*).

Some benefit from splintage has been displayed in patients with writer's cramp (*Tas et al 2001; Singer and Weiner 1995*). Lederman (*1998*) reports on four bagpipers with focal dystonia, one of whom devised some splints that he found helpful in decreasing the dystonic finger movements.

## SENSORY MOTOR RETUNING (CONSTRAINT-INDUCED MOVEMENT THERAPY)

Constraint-induced movement therapy (CIMT) is a behavioural therapy approach that has been trialled and proven to be effective with stroke patients (*Taub et al 1993 and 1999*). The nonaffected limb is immobilised in a cast, thus encouraging the affected limb to be used. These principles have been generalised and trialled for treatment of patients with focal hand dystonia. They have been labelled sensory motor retuning (SMR) (*Candia et al 1999*). The intervention involves fixing the 'compensating' finger for the dystonic movements in a splint, while the 'dystonic' finger carries out repetitive co-ordination exercises. Exercises are completed under therapist supervision and involve one or more of the other digits to exercise up to 2.5 hours per day for eight consecutive days. (See Appendix 2 for exercises and exercise schedule) (*Candia et al 2002 and 2003*). Candia et al (*2002 and 2003*) have published findings of two studies where improvements in both objective and subjective measurements, utilising a dexterity displacement device and patient self-rating dystonia evaluation scale, were noted. The first study (*Candia et al 1999*) was based on five musicians and the results supported the authors' beliefs that SMR produces short-term functional improvements associated with neuronal reorganisation. The second study (*Candia et al 2002*) involved 11 professional musicians and evaluated the long-term effects of SMR. The results suggest that SMR is a valuable treatment technique for pianists and guitarists, as each of these subjects displayed improved spontaneous repertoire performance without the splint. The wind players did not display any improvement, and the authors offer two explanations for this: either finger-mouth co-ordination affects brain mechanisms, or SMR is not effective in treating performers with focal dystonia who exert a fairly constant and firm force whilst playing.

**Figures 3a and b: Immobilisation splint**

## LIMB IMMOBILISATION

Prolonged immobilisation of the forearm and hand for four to five weeks has been tested as a treatment for patients with musician's cramp (*Priori et al 2001*). Directly after the removal of the splint, patients displayed weakness and clumsiness, but after they regained voluntary movement improvements lasted for up to 24 weeks in 50% of the patients. The authors claim that immobilisation allows for plastic changes to occur at the cortical level (*Pesenti et al 2001*), and that prolonged immobilisation, used in conjunction with post-splintage rehabilitation, may lead to better therapeutic results for patients affected by focal hand dystonia (*Priori et al 2001*). A larger sample group, studied under controlled conditions, is needed in order to validate this treatment for general use. Information regarding ideal length of immobilisation, number of joints to splint, rehabilitation regimes post-splintage, and clinical features that would indicate patients who would benefit from the treatment need to be scientifically stated.

### OCCUPATIONAL THERAPY AND PHYSIOTHERAPY

Physiotherapy and occupational therapy play an important role in performing arts medicine (*Hoppmann 2001*). Splinting, adaptive devices, heat, ice, exercise, electrical modalities, rehabilitation and preventative measures can be useful in treating the injured instrumentalist. Chen and Hallett (*1998*) state that they use occupational therapy as one treatment option for patients with writer's cramp, whilst Berg and Naumann (*1998*) comment that they prefer treating this patient group with occupational therapy in conjunction with botulinum toxin. Hochberg et al (*1990*) prefer to see if conservative hand therapy treatment, such as strengthening exercises for weak hand muscles (interossei, lumbricals, abductor pollicus longus and brevis) is effective before they utilise pharmacological intervention.

### MULTI-DISCIPLINARY APPROACH

No single treatment modality seems to be effective for the treatment of focal dystonia. In the multi-disciplinary approach, many treatments can be integrated, and occupational therapy and physiotherapy play an important role. The choice of treatments depends on the patient's symptoms. Each treatment programme is individual and changes according to the short- and long-term goals of the affected patient and those treating them. When assessing and treating a patient with focal hand dystonia, a whole body approach must be emphasised (*Kember 1997; Byl 2000*). Treatments such as soft tissue massage, neural mobilisation, splintage, intrinsic muscle strengthening and sensory discrimination exercises may be useful (*Byl 2000*). Other evaluations and treatments, such as finding positions where the patient can perform the given task normally, referring the patient to a teacher who is trained in working with injured musicians, and evaluating and making necessary recommendations/ alterations to the workplace and instrument may also be helpful (*Byl 2000*). Further recommendations may relate to the musician's general approach to life, for example: instruction in diaphragmatic breathing, ensuring the patient is well hydrated and has a healthy diet and encouraging involvement in a cardiovascular conditioning programme (*Byl 2000*). A comprehensive physiotherapy programme that includes an aggressive sensory re-education element, accompanied by exercises that facilitate fitness and musculoskeletal health, can improve sensory processing and motor control of the hand (*Byl and McKenzie 2000*).

Tubiana and colleagues propose a four-stage treatment programme for patients with focal dystonia. It is based on relaxation, deprogramming acquired bad habits and a complete rehabilitation of the neuromuscular system (*Chamagne 1983 and 1996; Tubiana and Chamagne 1983; Tubiana 1998*). The stages are: reconstructing the patient's body image, relaxation training and muscle differentiation, individual muscle retraining, and technical retraining on the instrument. Tubiana and colleagues believe that re-education involves the whole body and the mind, not just the upper limb. Tubiana and Chamagne report that trust and co-operation in the therapeutic relationship is essential for treatment success. Patients must be dedicated to participating in the retraining programme. Brockman et al (*1993*) present the results of 483 patients who utilised this treatment programme: 95 returned to concert performance, 286 had partial improvement, and 57 reported no improvement. For a detailed review of this treatment approach, refer to Chamagne (*2000*).

These findings indicate that a multi-disciplinary approach to the treatment of patients with focal hand dystonia is probably the most effective. However, the treatments are slow and time-consuming and success does rely on the patient being motivated and performing the exercises regularly and carefully. Muscle strengthening, appropriate modification to instruments, medications and botulinum toxin injections are utilised by Hochberg et al (*1990*) to treat patients with focal hand dystonia.

## SUPPORTIVE APPROACHES

### ASSISTIVE DEVICES/ MODIFICATIONS TO INSTRUMENT

Singer and Weiner (*1995*) comment, but do not provide a scientific base, that a writing aid may benefit patients with writer's cramp. Koller and Vetere-Overfield (*1989*) present a patient who had tried various medications over a five to six-year history of writer's cramp, who found benefit from a small writing block that was advertised as an aide for people with arthritis. The authors say that a writing device can be viewed as a 'sensory trick' and should be trialled before pharmacological or botulinum toxin intervention, as it is non-invasive and has no adverse effects. A similar approach should be tested with musicians, where a change in instrument may be able to decrease or improve symptoms. Hochberg et al (*1990*) comment that modifications to musical instruments can eliminate postural triggers, decreasing focal dystonic symptoms and have profound benefits for the patient. Possible modifications

include: changing to a smaller instrument, using a neck support, altering location of thumb supports, altering bridge and string height and extending or altering finger supports.

### FELDENKREIS THERAPY AND ALEXANDER TECHNIQUE

Nelson (*1989*) and Hoppmann (*2001*) state respectively, that Feldenkreis therapy and Alexander technique can be utilised as treatments for patients with focal hand dystonia. They believe patients gain an awareness of control, with simple movements being practised initially, and then more complex patterns being introduced once control of muscle activity and relaxation techniques have been learnt. No scientific studies were found to support or refute the use of these techniques for musicians with focal hand dystonia.

### BIOFEEDBACK THERAPY

It is felt that biofeedback, when used in conjunction with occupational therapy (*Hochberg et al 1990*) or physiotherapy (*Singer and Weiner 1995*), may be useful to re-educate muscles that have been affected by focal dystonia. Biofeedback can be used to help patients eliminate muscle co-contraction, and patients are asked to hold and palpate the target instrument but are not permitted to play it until involuntary movements are controlled (*Byl and McKenzie 2000*). However, in a controlled study on spasmodic torticollis patients, subjective improvements in symptoms were noted in both control and treatment groups (*Byl 2000*). These subjective results were not associated with significant changes in objective measures, thus the authors conclude that the sole use of EMG biofeedback for treating torticollis is not supported. More research is needed into the effectiveness of biofeedback as a treatment for focal hand dystonia.

**Figures 4a and b: Instrument modifications can include wrapping the end of a bow in Coban and adding a Blu Tack bow 'build-up'.**

### COUNSELLING AND PSYCHOTHERAPY

Lim et al (*2001*) comment that dystonic movements occur predominately while performing perceptual-motor tasks involving emotion. It is noted that there is difficulty in changing emotional and motor traces that have become associated, and this may lead to preservation of dystonic symptoms. Psychosocial and somatic aspects are interacting in patients with focal dystonia, and thus psychotherapeutic support in addition to botulinum toxin is indicated for some patients (*Erbguth 1997*). Tubiana (*2000*) comments that treating therapists often have a psychological action that is inseparable from the rehabilitation, due to developing a therapeutic rapport with the patient after spending long amounts of time with them throughout their treatment regime. Emotional support can be imperative when a musician is affected by such a disabling condition as focal dystonia. Referral to professional help for clinical depression may be necessary (*Hoppmann 2001*). Kolle (*2000*) states that a psychological approach to treatment of patients with focal dystonia can play a role in rehabilitation, as it can examine the patient's goals and unconscious problems. If social problems are evident due to the dystonia, then support therapy may be useful. Short duration behavioural therapy could be appropriate if patients are experiencing difficulty in adhering to therapy regimes and in overcoming fears and returning to performance. Relaxation therapy may assist patients with difficulties relating to perception of their surroundings and self.

## PREVENTION OF FOCAL HAND DYSTONIA

The key to treatment is prevention (*Sataloff et al 1991; Slade et al 1999*), therefore to decrease chances of a musician developing an injury they should try to avoid: irregular practice with highly intense periods of practice and performance, unnecessary changes in instrument or technique, learning a lot of new repertoire at the same time, unrelated hand-over activity, trauma to the hands and emotional stress. Musicians should instigate sensible practice techniques with regular breaks and reasonable total playing/practice time; utilise strong but flexible bodies that are well conditioned; perform warm-up and cool-down exercises

and gradually increase the intensity and duration of their playing. A holistic approach must be adapted, where locomotor problems are corrected and playing technique, lifestyle, psychosocial and emotional factors are carefully assessed and re-instructed and/or modified as necessary (*Wynn Parry 1998*). Stress and anxiety before a performance, temporal-spatial constraints of the instrument and playing, overuse and hours practised should all be controlled, thus hopefully minimising the possible risk of developing focal hand dystonia (*Lim et al 2001*).

Tubiana and Chamagne (*2000*) and Altenmüller (*1998*) believe that freedom of interpretation in musicians who improvise, and freedom from external pressures in amateur musicians, may be preventative factors in the development of focal dystonia. Newmark and Lederman (*1987*) carried out research on musicians at a conference. Most of the players (73%, 79/109 with only two being professional musicians) did not usually perform routine practice. had a rapid increase in playing time and were predisposed to over-use injuries. 81% (48/79) of those with a significant practice increase developed new playing related complaints, whilst 63% (27/79) experienced problems even without a significant increase in playing time. The authors comment that musicians should view themselves as athletes, be more attentive to their physical limitations and condition their bodies accordingly, in the hope of preventing over-use injuries. They hope that teachers, performers and physicians learn from the experiences of their respondents and implement a carefully planned increase to playing time.

Animal studies show that highly repetitive motor movement contributes to degradation in the somatosensory cortex. However, when the speed and force of the repetitive motor tasks are varied and interspersed with other regular activities, the degradation of hand cortical representation and loss of motor control can be minimised (*Byl et al 1997*). Thus, it is important to maintain instruments in top playing condition, with the hope of decreasing excessive energy outlay for desired level of performance (*Hoppmann 2001*). Musicians need to intersperse practice and playing with other activities in order to decrease the chances of developing focal dystonia and other conditions.

## FUTURE RESEARCH

Controlled studies are needed to assess whether therapeutic benefit is accompanied by functional changes in the brain. Objective parameters need to be established, in order to measure the effectiveness of treatments. Finger force and velocity pre- and post-therapeutic intervention may be useful objective measurements. The longevity and degree of treatment effectiveness needs to be assessed. Assessment of the musician's repertoire and performance levels before onset of focal dystonia, and following treatment, need evaluation. Circulation of standardised research-based treatment regimes to musicians, music teachers and the treating multi-disciplinary team should ensure a validated knowledge base with working guidelines.

There is limited evidence surrounding the effectiveness of treatments such as hydrotherapy, acupuncture, chiropractics, dietary changes, exercise and magnetic devices for the treatment of focal hand dystonia. It is necessary for scientific research projects into the effectiveness and long-term benefits of these modalities to be completed.

With regard to sensory re-education, future developments may lean towards the use of computerised sensory stimulators to increase sensory retraining efficiency. Byl and McKenzie (*2000*) suggest there is a need for computer technology '...to provide intense, goal-directed, suitable, motivating, repetitive, and discriminatory sensory stimulation to patients.' The challenge is to negotiate with compensatory bodies and maintain motivation levels with patients, so that sensory discriminative task performance continues until enough cortical sensory remapping has occurred to allow normal motor control (*Byl and Topp 1998*). Availability of computerized equipment, that increases the intensity of repetition and the gradation of the sensory decisions, may shorten retraining times and make tasks more interesting (*Byl and Topp 1998*).

## CONCLUSION

An increased focus on health issues relating to the performing artist has occurred in recent years, highlighting the frequency and debilitating effects of focal hand dystonia affecting musicians. Use of splints, biofeedback, mechanical aids, technical retraining, botulinum toxin injections and oral medications may provide some relief of symptoms. However, there is a need to identify the mechanisms accurately by which focal dystonia develops in musicians. More research into the pathophysiology needs to be undertaken to support the development of strategies for prevention and treatment of this condition. As a first step towards this goal, an impairment of sensory-motor control has been identified in musician's dystonia and treatment strategies that aim at re-establishing physiological sensory-motor

integration in the brain are shown to be effective in reducing dystonic symptoms (*Candia et al 2003*).

A comprehensive hand therapy programme with an aggressive sensory re-education element, accompanied by exercises that facilitate fitness and musculoskeletal health, can improve sensory processing and motor control of the hand. Dialogue between health care professionals, teachers and performers needs to be free, so that effective treatment and preventative measures can be facilitated and implemented. Prevention is the primary aim of performing arts medicine. Mutual education is imperative for informing and overcoming barriers amongst all people that come into contact with, and are affected by, focal hand dystonia. Encouragingly, recent investigation into focal dystonia is more frequently of a scientific nature, rather than the descriptive methods of the past. Collaboration and a multi-disciplinary team approach to prevention, treatment and research are imperative and will be of benefit to all.

**Appendix 1**
**Graded return to play programme**

| PRACTICE SESSIONS PER DAY | MINUTES OF PLAYING |
|---|---|
| Two sessions shadow playing | 3-5 minutes |
| Two sessions on instrument | 3-5 minutes |
| Two sessions | 5-10 minutes |
| Two sessions | 15 minutes |
| Two sessions | 20 minutes |
| Three sessions | 15 minutes |
| Three sessions | 20 minutes |
| Four sessions | 20 minutes |
| Four sessions | 30 minutes |
| Three sessions | 45 minutes |
| Three sessions | 60 minutes |
| Two sessions | 90 minutes |
| Two sessions | 120 minutes |

**Start with Simple, Slow and Soft music**
**Double minutes of playing every few days**
**Drop back a level if pain is elicited**
**Gradually progress repertoire difficulty**
**A five-minute break is encouraged every 20 minutes at the higher levels of playing**

**Appendix 2 - Exercises and exercise schedule**

The 'focal dystonic digit' and the digit(s) that perform compensatory movements for the dystonic one are identified. A splint that immobilises the main compensatory finger and in turn permits independent movement of the dystonic finger is then fabricated.

Sequential exercises are then performed, in which the subject makes movements of two or three digits in extension, including the focal dystonic digit. These exercises are performed for a 10-minute period, in a continuous ascending and descending order (e.g. D2, D3, D4, D3, D2 etc. with D4 being the focal dystonic finger and D5 the immobilised main compensatory finger). The patient then rests for two minutes. Following the rest, a different sequence of movements of two or three fingers, including the focal dystonic finger, are completed. Five blocks of exercises are performed in an hour.

Initially, the exercise task is paced by a metronome and begins at a medium tempo (60bpm). The tempo is then increased and gradually decreased, as some musicians with dystonia find slow, controlled movements more difficult than fast ones.

After completing the first five blocks of exercises, the splint is removed and patients can rest for 10 minutes. Following this, four more 10-minute blocks of exercise with two-minute rest breaks between the blocks are completed. A variety of possible finger movements are performed in the different exercise blocks.

Subjects then have a rest of about 40 minutes. The patient is then encouraged to play their instrument without the splint. They are invited to play a piece of music of their choice for 15-30 seconds. If they cannot do this, they are encouraged to try a second time. After two successful repetitions, they are asked to play a new, longer segment of the piece, until they have played for 15 minutes (excluding rest breaks). After a five-minute break, if the patient is not too fatigued, the splint is reapplied and a second series of alternating digital manoeuvres, each of five-minute duration, is performed. This regimen continues for eight consecutive days.

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