Because of the increasing number of musicians seen in my hand clinics and because of the time needed for their examinations, in 1975 with the assistance of my physiotherapist Philippe Chamagne, I established a monthly medical clinic for musicians. Since then, we have seen more than 4000 musicians with medical problems of the upper extremity, about 600 of whom were diagnosed with a focal dystonia (FD). This unusually high proportion of patients with FD is probably the result of our early interest and publications in this area.1,2

All 4000 patients were given a complete physical examination. From these examinations, we were struck by two obvious findings: 1) the frequency of problems of posture and movements and of muscle imbalance (seen in most of the patients with FD), and 2) the psychological repercussions of their musical frustration.

We decided to attempt to correct the most significant deformities through a rehabilitation program. We were encouraged to pursue this program by the personal experience of Philippe Chamagne, who years earlier had suffered a writer’s cramp and, due to his profession, was able to cure himself after a prolonged rehabilitation.3 In 1991, we reported an evaluation of our treatment results.4 Although the results seemed to have improved over time, we concluded this review as follows: “These results must be reviewed with caution because of the initial lack of patient selection and because the therapy protocol was firmly established only after a long trial period.”5

For these reasons, we re-evaluated our results in 2000, this time using well-selected patients and a well-established therapy protocol.6 Also, we graded patient outcomes according to a classification of six stages of dystonia severity, which provides an assessment of the instrumentalist’s musical capabilities at the onset of the treatment and after rehabilitation (Table 1). Between 1992 and 1999, we saw 145 cases of musician’s FD, and our results are the subject of this paper.

BACKGROUND AND MUSICIAN EXAMINATION

The exact cause of FD, a neurologic movement disorder, remains unknown. However, in our experience, several factors seem to influence the development of FD. In many of these cases, the onset was found to coincide with a period of especially intense musical activity or after a change in musical behavior. Any changes in long-established musical habits can lead to unaccustomed tension (both biomechanical and psychological). In some patients, other factors also may play an etiologic role, including 1) chronic pain due to overuse/misuse or nerve compression and 2) trauma.

The same individual or a family member may occasionally have other types of dystonia, such as writer’s cramp, torticollis, or blepharospasm. Although in our experience, these cases are rare, they nevertheless indicate that a certain susceptibility for developing FD may exist.

The most common inciting factors in our experience have been biomechanical and psychological. Of course, FD should not be attributed to a purely psychological origins; as Decourt writes, “This does not deny the emotional behavior common in artists, and the apprehension they have of the socioeconomic consequences may lead to an obsessional state which one must take into account.”7 It is well known that stress can cause muscular tension, particularly in the trapezius and neck areas.

A complete physical examination is necessary to evaluate the mechanical disturbances.
Examination without the instrument shows muscular imbalances or deficiencies that are not specific for FD but that are often found in musicians with FD. Muscular imbalance is extremely frequent at the level of the scapulothoracic girdle, in those muscles responsible for positioning shoulder axis. Disturbance of the scapula-stabilizing muscles causes internal rotation of the arm and affects the dynamics of the upper limb. Without proper support and positioning of the shoulder girdle, fine control of hand movements is problematic. Most of our patients showed a muscular disequilibrium between strong peripheral muscles of the limb used for fine movement and the often insufficiently used proximal stabilizing muscles.

A functional imbalance between the radial and ulnar parts of the hand is also often seen. This typically may involve a collapse of the fourth and fifth metacarpal heads. Also, limitation of abduction between the third and fourth fingers, as noted by Wilson and Wagner, is occasionally found and is perfectly apparent in the hand of Glenn Gould.

It is commonly said about FD that "neurological examination does not reveal any further abnormalities." However, in our cases, proprioception is often altered. This problem is easily tested by having the patient close his or her eyes, asking the musician to place the distal phalanx of a finger of the one hand in a flexed or extended position, and then to place the finger on the contralateral hand in the same position.

Assessment of the musician playing his or her instrument is vital, not only to reveal involuntary abnormal movements but also to identify nonphysiologic postures and movement compensations. While playing, it is impossible for instrumentalists to avoid momentary lapses from an ideal posture. However, numerous repetitions of a complex movement in a nonphysiologic position cause overworking of muscles and may lead to serious disorders. Because the majority of musicians with nonphysiological postures are able to maintain the accuracy of their movements, additional risk factors must exist provoking disturbances in fine motor control. In our opinion, additional risks factors for the development of FD are disorders of proprioception, an excessive emotional susceptibility, and/or sometimes a genetically determined predisposition.

Regarding psychological factors, it seems that most musicians suffering from FD have totally invested themselves in their profession; these people are intense perfectionists and have great artistic ambition. One can then understand the despair of the instrumentalist who can no longer control his or her hand. In most of our patients, we have found an independence between biomechanical and psychological factors.

This extensive examination is important for designing the therapeutic program, which is based on how and when the instrumentalist uses movements as compensation during a musical performance.

PROLONGED NEUROMUSCULAR REHABILITATION AS TREATMENT OF MUSICIAN’S FOCAL DYSTONIA

The goal of the treatment is to establish a new sensory motor program obtain through a complete rehabilitation of the neuromuscular system. Different methods exist that may be tried in order to achieve this goal. We have chosen to treat musician’s FD with a rehabilitation program that includes both physical and psychological components.

The treatment has been gradually refined. It consists of the musician being made aware of any poor posture, deprogramming the nonphysiologic movements, and then teaching movements that respect normal physiologic function. This re-education is not restricted to the hand, but includes the whole body. Prolonged rehabilitation tends to reestablish a physiologic posture that supports the freedom of movements by the musician with minimal expense of energy.

Once the neuromuscular program is established, it must be communicated to the patient in simple, understandable terms in order for the musician to recognize not only what is being done but also why. This approach maximizes the rehabilitation potential.

The prospect of a long period of rehabilitation may itself produce anxiety in the musician, not only for economic reasons but also for fear of being cut off from the musical community. Support therapy from a psychotherapist can help the musician to adhere to the long rehabilitation program. In any case, the instrumentalist must maintain some musical activity, whether playing with the other hand when possible or teaching in a music school.

Chamagne has developed a progressive therapeutic program with four phases. The details of these rehabilitative phases have been described in several previous publications. In summary, they are:

**Phase 1: Restructuring the Body Image**

Phase 1 is a preliminary phase in which the musician develops an appreciation of proprioceptive elements and learns techniques of stereognosis. Facing a mirror, the musician becomes aware of any poor posture. He or she must become conscious of the effect of gravity. The musician must ensure that the transverse axis through the shoulder joints and pelvis is placed squarely over the feet, and he or she must straighten the spine and position of the head and then find this balance with the eyes closed.

Because a physiotherapist who specializes in the treatment of musicians has close contact with the patient from the beginning of the treatment and over the longterm, he or she will also have a psychological effect on the patient. The physiotherapist will have the opportunity to hold a dialogue explaining the mechanism of the deformities. Before attempting to correct the inappropriate postures and movements, the
Management of the return to playing is particularly important. The activity must be progressive, with a gradual increase in the amount of time spent playing and also in the technical difficulty and tempo of the music. It requires the avoidance of positions and activities that provoke the dystonic symptoms. Progression to recovery is never linear; rather it is through a series of successive levels.

Rehabilitation is prolonged and may take several years (about 2 years on average in this series). The aim of the treatment is to give the instrumentalist an opportunity to play musical passages using physiologic movements at a normal speed, as well as to regain the instrumental sound that he or she had attained prior to the dystonia. This is quite difficult to achieve. The duration of rehabilitation depends mainly on the patient’s motivation.

RESULTS OF PROLONGED REHABILITATION OF MUSICIAN’S FOCAL DYSTONIA

We previously reported the detailed results of our rehabilitation program for musician’s FD, for cases treated between 1992 and 1999, divided according to the instrument played. Between 1992 and 1999, we saw 1320 musicians with upper limb problems, 145 of whom had FD (Table 2). FD was predominant in men (105 men, 40 women), and the average age of onset was 33 years.

Because of our specialization at the Hand Institute, we saw only a few cases of cervicofacial FD, which were those associated with upper limb dystonia. However, Chamagne, in the new Rehabilitation Center of Medecine des Arts, has treated these patients according to the same basic principles of prolonged rehabilitation and has seen encouraging results.

For our physical examination, we established a classification of six stages of FD severity, which provides an assessment of the musician’s musical capabilities at the onset of the treatment (Table 1). This same classification provides a basis for evaluating the results following treatment.

In short, from a total of 145 musicians with FD treated between 1992 and 1999, 35 failed to complete the rehabilitation. Of the 110 who finished the rehabilitation program, 25 showed no improvement, and 85 have shown more or less improvement, including 39 patients who returned to perform (Table 3).

In our experience, the higher the functional grade at the beginning of the treatment correlates with better results after rehabilitation. Other factors influencing results include the quality of the treatment, unfavorable psychological or morphologic conditions, and a delay between the onset of the problems and treatment. Age appears to influence the results, in that the prospect of a long and uncertain rehabilitation may be more difficult to tolerate for elderly musicians.

Also, the degree of cooperation of the patient is of critical importance. Artists who seem to react positively to rehabilitation are those who show a desire to understand how the body functions and hence to understand better the mechanism of the problem.

<table>
<thead>
<tr>
<th>Instrumentalists</th>
<th>Total No.</th>
<th>Right Hands</th>
<th>Left Hands</th>
<th>Lips</th>
<th>Right Foot</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pianists</td>
<td>46</td>
<td>42</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Guitarists</td>
<td>36</td>
<td>26</td>
<td>10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Violinists and violists</td>
<td>21</td>
<td>5</td>
<td>16</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flautists</td>
<td>12</td>
<td>1</td>
<td>8</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Piccolo player</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oboists</td>
<td>4</td>
<td>3</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Saxophonists</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bag piper</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clarinetists</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Accordionists</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Percussionists</td>
<td>7</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Organist</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Horn player</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bassoonist</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total no.</td>
<td>145</td>
<td>91</td>
<td>48</td>
<td>5</td>
<td>2</td>
</tr>
</tbody>
</table>

In our experience, the higher the functional grade at the beginning of the treatment correlates with better results after rehabilitation. Other factors influencing results include the quality of the treatment, unfavorable psychological or morphologic conditions, and a delay between the onset of the problems and treatment. Age appears to influence the results, in that the prospect of a long and uncertain rehabilitation may be more difficult to tolerate for elderly musicians.

Also, the degree of cooperation of the patient is of critical importance. Artists who seem to react positively to rehabilitation are those who show a desire to understand how the body functions and hence to understand better the mechanism of the problem.
The results of our prolonged rehabilitation treatment of musician’s FD are far from satisfactory in all cases and could probably be improved in cases. However, they show that musician’s FD is not invariable. Thirty-nine instrumentalists, among them some of international renown who had been obliged to interrupt their careers, returned to performance. After treatment, some musicians are still fatigued when concerts are scheduled too closely, and periodic reassessment of posture and movement is mandatory in order to avoid recurrences.

We agree with Altenmüller, when he says: 13 “Although the neurobiological origins of this disorder are not yet clarified, it is probable that musician’s FD is in most cases part of a cortical sensory-motor mis-learning syndrome, which in turn is due to dysfunctional brain plasticity.” It has now been demonstrated that daily musical training can induce functional reorganization of the cerebral cortex. 14,15 We believe that through the flexibility offered by neural plasticity, 16 it is possible in some individuals to teach a new neuromuscular reprogramming that respects normal physiology.

We do not believe that administration of botulinum A toxin constitutes the “treatment of choice” for musician’s FD. Although local injections of botulinum A toxin are effective in reducing the involuntary contraction of blepharospasms or torticollis, they do not appear to be as promising an option for musicians because of the musicians’ reluctance to submit to repeated injections. In 1991, Cole and colleagues 17 concluded a summary of their experience with botulinum toxin with these words: “FD in a musician is characterized by both spasms and a disorder of coordination. Improvement in the spasms can be accomplished, but the motor coordination component is not addressed with the treatment.”

We do not think that administration of botulinum A toxin, without neuromuscular rehabilitation, should be an option for musician’s FD. We agree, however, that in some severe localized contractions, administration of this toxin can be a useful adjuvant to the rehabilitation treatment.

In closing, our experience leads to several conclusions:

- The basis of therapy for musician’s FD is a long rehabilitation program.
- A multidisciplinary approach is the best way to treat this condition.

At the Musician’s Clinic at the Hand Institute, four specialists currently run the program: a hand surgeon (Prof. Tubiana), a neurologist (Prof. Rondot), a pediatrician (Prof. Malek), and a physiotherapist (Ph. Chamagne). The physician typically will make the diagnosis, prescribe the therapy, and control the evolution of the treatment. An experienced physiotherapist institutes de-programming and re-programming of the musician’s sensorimotor system. And finally, psychologists trained in the musicians’ problem help the musicians to lessen their frustration and assist them in developing a new perspective. The collaboration of instrumental teachers is also desirable and may be of great help.

Finally, considering the long-term investment required in the rehabilitation, personal factors of the musician influence the results. We have found that musicians with FD who adhere to the long rehabilitation program and who re-evaluate the basic aspects of their playing and some aspects of their professional behavior have the best chance for cure.

REFERENCES


TABLE 3. Results for 12 Pianists According to FD Scores

<table>
<thead>
<tr>
<th>Initial Grade</th>
<th>No. of Subjects</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>6</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>5</td>
<td></td>
<td>2</td>
<td>3</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>13</td>
<td></td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>12</td>
<td></td>
<td></td>
<td>2</td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>6</td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>