Chapter 17

Epidemiology, phenomenology, and therapy of musician’s cramp

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Introduction

Focal dystonia in musicians, also known as musician's cramp, is a task-specific movement disorder which presents itself as a painless muscular incoordination or loss of voluntary motor control of extensively trained movements while a musician is playing the instrument (Jankovic and Shale 1989; Lederman 1991; Brandfonbrener 1995; Frucht et al. 2001; Altenmüller 2003). For those who are affected focal dystonia is highly disabling, and in many cases terminates musical careers. According to estimations, 1% of all musicians are affected (Altenmüller 2003). In this chapter the phenomenology and epidemiology of musician’s dystonia are addressed on the basis of data from 144 affected musicians diagnosed and followed-up at the Institute of Music Physiology and Musicians’ Medicine of the Hannover University of Music and Drama. Data will be compared with those of other reports and discussed with regard to risk factors for the development of musician’s dystonia. Treatment strategies and results will be outlined based on a retrospective inquiry and self-evaluation of affected musicians treated with currently available therapies.

All 144 patients were professional musicians diagnosed with focal dystonia at our out-patient clinic between 1994 and 2001. The diagnostic procedure during their first visit included a complete neurological examination as well as visual inspection while patients were playing their instruments. None of the patients were suffering from secondary dystonias or other neurological disorders. For assessment of the phenomenological and epidemiological data, a retrospective chart review was performed. Data were statistically analysed using $\chi^2$-tests and Fisher’s exact tests to identify disproportionate frequencies in the clinical manifestation of subgroups of patients. The level of significance was set at $P < 0.05$.

Demographics, epidemiology, and phenomenology

The patient group consisted of 116 male (81%) and 28 female (19%) musicians. The mean age at onset of symptoms was 33 years (range 17–63 years) and the
mean duration of dystonic symptoms at the time of the first visit was 5.1 years (range 0.1–28 years). At the time of the onset of symptoms, 74 patients (51%) had professional positions as soloists and 24 (17%) were tutti players in orchestras, 25 patients (17%) had teaching positions, and 21 (15%) were students. Concerning the genre, 137 patients (95%) were classical musicians, 2 patients (1%) were jazz musicians, and 5 patients (4%) were pop musicians. Nine patients (6%) had a history of either writer’s cramp or musician’s dystonia in their family. The distribution of instrument groups was as follows: 22 patients (15%) were bowed string players, 40 patients (28%) were keyboard instrumentalists, 29 patients (20%) were playing plucked instruments, 37 patients (26%) were woodwind players, and 16 patients (11%) were brass players. The distribution of individual instruments is displayed in Fig. 17.1. In order to compare the distribution of instruments among dystonic musicians with that in a normal population of instrumentalists, the respective numbers of members in the German Orchestra Union were used according to the March 2004 statistics of the German Orchestra Union (representing over 90% of German orchestral musicians). In our patient group, 20 high string players (violin, viola) and 2 low string players (violoncello, double-bass) were affected. This ratio was higher than expected according to the distribution of 3810 high and 1464 low string players in the German Orchestra Union ($\chi^2 = 3.81$, d.f. = 1, $P = 0.05$). One hundred and twenty-four patients were suffering from focal upper limb dystonias (86%), which presented themselves mostly as hand dystonias in the

![Fig. 17.1 The instruments played by 144 patients with musician's dystonia. Instrument families are separated by vertical lines.](image)
typical manner with involuntary cramping of one or more fingers while patients were playing; one trombone player displayed dystonic movement patterns in his left upper arm. Embouchure dystonia was present in 20 patients (14%). Typical patterns of dystonic posture are displayed in Fig. 17.2. Details of the localization of focal dystonia in different instrument families are given in Fig. 17.3. $\chi^2$-tests of 115 patients with unilateral hand dystonia revealed a different laterality of focal hand dystonia in different instrument families ($\chi^2 = 23.5$, d.f. = 3,
keyboard musicians and those with plucked instruments were primarily affected in the right hand and string players in the left hand (Bonferroni-corrected follow-up $\chi^2$-tests; keyboard vs. string players: $\chi^2 = 13.3$, d.f. = 1, $P < 0.01$; keyboard musicians vs. musicians with plucked instruments: $\chi^2 = 13.6$, d.f. = 1, $P < 0.01$). No such lateralization was seen in woodwind players. Bilateral hand dystonia was seen only in keyboard instrumentalists and in woodwind players. Handedness was categorized as right-handed/ left-handed/ambidextrous according to the preferences in the use of hands in the activities of handwriting, eating with a spoon, and cutting with scissors. Among the patients with unilateral hand dystonia there were 108 right-handed patients and 5 left-handed patients; two patients were ambidextrous. Seventy-five right-handed patients had right-hand dystonia and 33 right-handed patients had left-hand dystonia. This pattern was inverse in left-handed patients: in four of these the left hand was affected and in one patient the right hand. These proportions were significantly different (Fisher’s exact test; $P < 0.05$).

Ninety-five patients (66%) had dystonic symptoms only while they were playing their instrument, whereas 49 patients (34%) had additional difficulties in other activities such as writing on the computer keyboard or in everyday activities. Local pain preceded focal dystonia in 13 (9%) patients: 7 patients (5%) experienced local pain only before onset of dystonic symptoms while 6 (4%) patients had pain in the affected region before and after onset of dystonic symptoms. Twenty-five (17%) patients reported local pain only after onset of dystonic symptoms, whereas 106 (74%) patients never experienced pain in the affected region.

Risk factors for the development of musician’s dystonia

The demographic data demonstrated a preponderance of male musicians in the sample of the present study, with a male:female ratio of 4:1. In other reports the male:female ratio of patients with musician’s dystonia was between 2:1 (Lederman 1991) and 5:1 (Lim and Altenmüller 2003). Since female musicians form the majority of the musicians in Germany, the latter ratio was corrected to 6:1 (Lim and Altenmüller 2003). Similarly, this effect has to be taken into account for the male:female ratio of 4:1 of the present sample of patients, which additionally underlines the increased risk of male musicians developing focal dystonia. A positive family history of dystonia, as seen in 6% of our patient group, has already been described in other reports as a risk factor for development of musician’s dystonia (Jankovic and Shale 1989; Altenmüller 2003; Lim and Altenmüller 2003). The mean age at onset of dystonic symptoms (33 years) observed in the present study harmonizes with other studies demonstrating a peak in the fourth decade of life (Lederman 1991; Brandfonbrener 1995; Brandfonbrener and Robson 2002; Altenmüller 2003).
Our results demonstrated a correspondence between the instrument group and the localization of focal dystonia. This is obvious for brass players who suffer predominantly from embouchure dystonia. Additionally, among the musicians with unilateral hand dystonia, the correspondence between the instrument group and the localization of focal dystonia was significant. Keyboard musicians (piano, organ, harpsichord) and those with plucked instruments (guitar, e-bass; no harpists) were primarily affected in the right hand. All these instruments are characterized by a higher workload in the right hand. Correspondingly, bowed string players who have a higher workload and complexity of movements in the left hand were predominantly affected in the left hand. These observations agree with other reports (Tubiana and Chamagne 2000; Brandfonbrener and Robson 2002; Schuele and Lederman 2004). Moreover, focal hand dystonia in both hands was only seen in those musicians with instruments requiring similar movement patterns in both hands (although with a different workload), such as woodwind and keyboard instruments. Within the string family, musicians who were playing the high string instruments (violin, viola) were more often affected than those with low string instruments (violoncello, double-bass). The observed occurrence in high string players was significantly higher than expected according to the overall distribution of high and low string players among German orchestral musicians. The demands on spatial sensorimotor precision required for violin and viola playing are higher than for the low string instruments. Thus, those musicians with instruments requiring highest spatial sensorimotor precision were primarily affected by dystonia. Furthermore, in our sample of musicians with unilateral hand dystonia a context was observed between the handedness and the side affected by dystonia. The majority of right-handed patients was affected in the right hand and the majority of left-handed patients was affected in the left hand. Although the number of left-handed patients was small, this difference was significant and indicated that the hand with a higher total workload tended to be affected. It is noteworthy that there was no string player in the group of left-handed patients. The musical genre of the overwhelming majority of patients was classical music. In contrast to pop or jazz music with improvised structures and great freedom of interpretation, musical constraints are most severe in classical music. The latter requires a maximum of temporal accuracy in the range of milliseconds which is scrutinized by the performing musician as well as by the audience at any moment of the performance. This, as a consequence, combines the situation of public performance in classical music with a high level of social pressure: the gap between success and failure is minimal in this genre.

Taken together, epidemiological findings indicate that the workload of the respective body part, the complexity of movements, and the degree of spatial and
temporal sensorimotor precision as well as the level of social constraints associated with the musical performance were related to the occurrence of musician's dystonia.

Pathophysiological findings
The pathophysiology of focal dystonia remains unclear. Beside of alterations in the circuitry of the basal ganglia (Naumann et al. 1998; Preibisch et al. 2001) and dysfunctional plasticity in the sensory thalamus (Lenz and Byl 1999; Hua et al. 2000), there is growing evidence for abnormal cortical processing of sensory information as well as degraded representation of motor function in patients with focal dystonia (Deuschl et al. 1995; Hallett 1998; Elbert et al. 1998; Bara-Jimenez et al. 1998; Pujol et al. 2000). Cortical inhibition was found to be decreased in dystonic patients (Deuschl et al. 1995; Toro et al. 2000; Hummel et al. 2002). In animal studies, repetitive movements induced symptoms of focal hand dystonia and a distortion of the cortical somatosensory representation in monkeys (Byl et al. 1996) suggesting that practice-induced alterations in cortical processing may play a role in focal hand dystonia. Recently, behavioural treatment in patients with focal hand dystonia resulted in clinical amelioration and in reversed distortions of the somatosensory map, giving additional evidence for a practice-induced alteration of the cortical map (Candia et al. 2003). The importance of practice and the use of the limb in musician's dystonia was additionally underlined by the finding of improvement in symptoms after immobilization of the affected limb in dystonic musicians (Priori et al. 2003; see also Chapter 19). An impressive finding was reported by Rosenkranz and colleagues who used focal vibratory input to individual hand muscles to produce sensory input whilst the excitability of corticospinal outputs to the vibrated and other hand muscles was evaluated with transcranial magnetic stimulation (Rosenkranz et al. 2005, see also Chapter 18). In musicians with dystonia, focal vibratory input to hand muscles resulted in abnormally suppressed short-latency intracortical inhibition of all other hand muscles examined, independent of their functional connectivity with the vibrated muscles. In healthy non-musicians, such vibratory input increased short-latency intracortical inhibition of neighbouring muscles. In healthy musicians, however, vibratory input resulted in a suppressed short-latency intracortical inhibition only of those neighbouring muscles functionally connected with the vibrated muscles. In patients with writer's cramp, short-latency intracortical inhibition of neighbouring muscles was unchanged. It was concluded that the pathophysiology of musician's dystonia differs from that of writer's cramp. Furthermore, it was hypothesized that long hours of practising complex movements first produce the modulation of
sensorimotor interaction seen in healthy musicians, and that this later progresses into the non-focal pattern of short-latency intracortical inhibition in musician's dystonia (Rosenkranz et al. 2005).

The findings of an increased workload and complexity of movements as well as increased spatial and temporal sensorimotor requirements being related to musician's dystonia are in agreement with the hypothesis of a pathomechanism which includes practice-induced alterations. A higher workload in affected musicians might additionally be reflected by the observation of a more perfectionist attitude in dystonic musicians—even before onset of dystonia—compared with other musicians (Jabusch et al. 2004a) and by the finding of a preponderance of soloists (51%) in our sample of dystonic musicians. A perfectionist attitude as well as an outstanding professional position might point at a different and more intense working behaviour resulting in a higher workload in those musicians who develop focal dystonia.

Local pain and intensified sensory input for various reasons like nerve entrapment or trauma or overuse have been described as potential triggers of dystonia (Jankovic and Shale 1989; Lederman 1991; Charness et al. 1996; Altenmüller 2003). The parallels of abnormal cortical processing of sensory information and cortical reorganization in patients with focal dystonia and those with chronic pain have already been reported (Flor et al. 1997; Tinazzi et al. 2000; Jabusch et al. 2004a). Local pain preceded focal dystonia in 9% of the patients in the present study.

Possible interaction between predisposition and extrinsic and intrinsic factors

In view of the neurophysiological, epidemiological, and psychological findings in musicians with focal dystonia, predisposing factors have been described, such as male gender (Lederman 1991; Altenmüller 2003; Lim and Altenmüller 2003) as well as a positive family history (Jankovic and Shale 1989; Altenmüller 2003; Lim and Altenmüller 2003) which might constitute a particular vulnerability or susceptibility to musician’s dystonia. Additional extrinsic and intrinsic factors may trigger the manifestation of musician’s dystonia on the basis of a given susceptibility. Intrinsic triggering factors are physical disorders resulting in local pain and/or intensified somatosensory input (trauma, nerve entrapment, overuse injury) (Lederman 1991; Charness et al. 1996; Altenmüller 2003) as well as psychological conditions such as perfectionism and anxiety which were found to be related to musician’s dystonia (Jabusch et al. 2004a). According to Rosenkranz et al. (2005), intracortical disinhibition in musician’s dystonia might be an acquired, practice-induced phenomenon. Extrinsic triggering
factors, according to epidemiological findings (Tubiana and Chamagne 2000; Brandfonbrener and Robson 2002; Schuele and Lederman 2004), are spatial and temporal sensorimotor constraints as well as musical and social constraints typical of the performance situation in classical music. The possible interaction between predisposition and intrinsic and extrinsic triggering factors in the manifestation of musician’s dystonia is displayed in Fig. 17.4.

Treatment strategies and results

For a survey of treatment results, 160 consecutive professional musicians and music students with musician’s dystonia were recruited (Jabusch et al. 2005). Treatment strategies included: medication with trihexyphenidyl; injection therapy with botulinum toxin; ergonomic changes; pedagogical retraining; non-specific exercises on the instrument. Outcome data were assessed using a standardized questionnaire which was mailed to patients. Those patients who did not respond were contacted by phone, and a standardized interview was conducted using the questionnaire. Patients were asked to estimate (1) the cumulative treatment response on a four-step scale (free of symptoms, improved, no change, deteriorated); (2) the treatment response to individual therapies (improvement, no effect, deterioration). They were asked about (3) the nature and duration of therapies not applied by the authors (e.g. exercises on the instrument) and (4) their musical activity and professional situation at that time.
Outcome data for the aforementioned 144 patients could be obtained. Data were analysed using $\chi^2$-tests for outcome measures and multiple regression analyses for predictability of treatment responses. Percentage rates were calculated based on the total number of available answers.

**Long-term outcome**

The mean age at the time of the completion of the questionnaire was 42 years (range 23–69 years). Outcome was revealed on average 8.4 years after onset of dystonic symptoms (range 1–30 years) and 3.4 years after the initial visit (range 1–8 years). At the time of the survey, two patients (1%) were free of symptoms, 75 patients (52%) reported an alleviation of symptoms as compared with the time of their first visit, 50 patients (35%) did not notice any changes and 16 patients (11%) reported a deterioration. Regardless of treatment, a smaller fraction of patients with embouchure dystonia showed an improvement (3 of 20 patients) compared with those with limb dystonia (62 of 123 patients; $\chi^2 = 8.7$, d.f. = 1, $P < 0.01$). A change of profession was reported by 35 patients (29%). A larger fraction of music students changed their profession (12 of 21 patients, 57%) compared with those who were already in their professional careers at onset of symptoms (23 of 100 patients; $\chi^2 = 9.84$, d.f. = 1, $P < 0.01$) (Jabusch et al. 2005).

**Trihexyphenidyl**

Trihexyphenidyl was given to patients with all kinds of musician’s cramps when no contraindication was present. Trihexyphenidyl was administered beginning with 1 mg/day, and the dosage was slowly increased until therapeutic effects were observed. Adjustment of the dosage was made depending on beneficial effects and side-effects. Patients with side-effects and no improvement of symptoms were withdrawn from trihexyphenidyl treatment.

Trihexyphenidyl was applied in 69 patients (48% of all) with an average maximum dosage of 11 mg/day (range 1–30 mg/day). Within 2 months the medication was interrupted in 20 patients due to side-effects or unsatisfactory treatment response. The other 49 patients (34% of all) received trihexyphenidyl on average for 16 months (range 3–67 months). The most frequent side-effects were dry mouth (29 patients; 42% of patients receiving trihexyphenidyl), tiredness (15 patients; 22%), dizziness (13 patients; 19%), agitation (10 patients; 14%), memory impairment (8 patients; 12%), drowsiness (7 patients; 10%), depression (7 patients; 10%), loss of concentration (5 patients; 7%), nausea (4 patients; 6%), hyperkinesia (3 patients; 4%), impaired visual accommodation (2 patients; 3%), and tremor (2 patients; 3%). The average minimum dosage at which side-effects occurred was 9 mg/day (range 1–20 mg/day). Due to
side-effects, 16 patients (23%) were withdrawn from trihexyphenidyl. Side-effects were not related to age or gender. After trihexyphenidyl, an improvement was reported by a total of 23 patients (33%) and by 19 patients with limb dystonia who received trihexyphenidyl for more than 2 months (42% of these; average duration 26 months). Patients’ rating of treatment results is displayed in Fig. 17.5. None of five patients with embouchure dystonia showed an improvement after trihexyphenidyl. The occurrence of side-effects was not significantly different in patients who reported an improvement after trihexyphenidyl (side-effects present in 22 out of 23 patients) than in patients with no improvement (side-effects present in 32 out of 44 patients). The average maximum dosage of trihexyphenidyl was 11 mg/day (range 4–30 mg/day) in patients who had an improvement and 11 mg/day (range 1–20 mg/day) in patients with no improvement. Multiple regression analysis revealed a model predicting 49% of the variance of patients’ rating of trihexyphenidyl effects ($R^2 = 0.52; R^2$ adjusted = 0.49). The following variables predicted a positive rating: limb localization of dystonia (versus embouchure dystonia: $\beta = 0.59; \text{d.f.} = 1; F = 37; P < 0.001$), a high maximum dosage of trihexyphenidyl ($\beta = 0.28; \text{d.f.} = 1; F = 6.8; P = 0.01$), a low number of concomitant treatments ($\beta = -0.35; \text{d.f.} = 1; F = 11; P < 0.01$). The variables age, gender, localized versus non-localized dystonia (localized dystonia affecting one or two fingers versus non-localized dystonia), type of dystonia (flexion/extension/embouchure), task specificity at first visit, and duration of dystonia were not sufficient predictors of the rating of the effects of trihexyphenidyl.

![Fig. 17.5 Patients’ rating of treatment results: black bars, deterioration of dystonic symptoms; grey bars, no change in dystonic symptoms; white bars, alleviation of dystonic symptoms; hatched bars, no answer. Trihexyphenidyl (Trhx): results are given separately for all patients who received Trhx versus for those who received Trhx for more than 2 months. Botulinum toxin (BT): results are given separately for all patients who received BT versus for those who received more than one injection. (From Jabusch et al. 2005.)](image-url)
A limb localization of dystonia, a high maximum dosage, and a low number of concomitant treatments were found to predict a positive outcome of treatment with trihexyphenidyl. The low number of concomitant treatments may be a consequence of a successful treatment with trihexyphenidyl in some patients which limits its value as a predictor variable. A high maximum dosage was a sufficient, but not necessary, condition for an improvement. One patient who tolerated a maximum dosage of 30 mg/day had an improvement, but in other patients an improvement was seen after low dosages. However, there was no patient with high maximum dosages in the group of non-responders to trihexyphenidyl. There was no difference in the occurrence of side-effects between responders and non-responders. All patients with embouchure dystonias were non-responders. As a conclusion, a treatment attempt with trihexyphenidyl appears to be an option for musicians with limb dystonia when no contraindications are present (Jabusch et al. 2005).

**Botulinum toxin**

Botulinum toxin A (BT) injections were recommended only to those patients in whom primary dystonic movements could be clearly distinguished from secondary compensatory movements. A lyophilized botulinum toxin A powder (Dysport®, Ipsen Ltd, Berkshire, UK) was injected using an electromyographic (EMG)-guided technique (Karp et al. 1994; Schuele et al. 2005). Target muscles were identified by visual inspection of the dystonic movements while patients were playing their instruments. In patients with flexion or extension dystonia of individual fingers, injections in the forearm muscles were preferred. Additional injections in the hand muscles were performed in patients with dystonic flexion in the metacarpophalangeal (MCP) joints and an extension component in the proximal interphalangeal (PIP) and distal interphalangeal (DIP) joints.

Botulinum toxin injections were applied in 71 patients (49%), three of whom had embouchure dystonia. Eighteen patients had only one injection due to unsatisfactory treatment results. Five patients who reported an improvement were not satisfied enough to continue BT treatment. Fifty-three patients (37%) received more than one injection (average 5.7 injections per patient, range 2–25) with an average treatment duration of 16 months (range 1–58 months) and an average interval of 4.2 months (range 1–22 months) between treatment sessions. The average dosage per treatment session was 128 units (range 9–428). The most injected muscles were the flexor digitorum superficialis and the flexor digitorum profundus (50 patients each; 70% of patients treated with BT), followed by the flexor carpi radialis (13 patients; 18%), the flexor pollicis longus, the extensor digitorum and the extensor indicis (7 patients each; 10%), and the interosseus palmaris (5 patients; 7%). The average dosage per muscle group was 112 units.
(range 88–150) in the upper arm and shoulder muscles, 38 units (range 5–85) in forearm extensors, 65 units (range 10–175) in forearm flexors, and 26 units (range 5–84) in hand muscles. After BT, an improvement was reported by 35 patients (49%) and by 30 patients who received more than one injection (57% of these; average duration 26 months). Of the latter group, 21 of 33 patients with injections given only in the forearm muscles reported an improvement (64%), and 7 of 13 patients with injections in the forearm muscles and hand muscles (54%) had an improvement: two out of two keyboard players, two of four woodwind players, and three of four guitarists with the right hand affected. No improvement was seen in the affected left hands of one guitarist and two string players after injections in the forearm muscles and hand muscles. Neither of two patients with injections in the upper arm/shoulder muscles experienced an improvement and none of three patients with embouchure dystonia experienced an improvement after BT. Multiple regression analysis did not reveal any of the following variables as predictors of outcome after BT: gender, age, duration of dystonia, localized versus non-localized dystonia, type of dystonia, target muscles, mean BT dosage, task specificity at first visit, number of concomitant treatments. Positive rating of BT effects was correlated to the number of BT treatment sessions (Spearman $r = 0.37, P < 0.01$) and the duration of BT treatment (Spearman $r = 0.56, P < 0.01$).

According to these results, BT treatment was successful in those patients in whom primary dystonic movements could be clearly distinguished from secondary compensatory movements. This was difficult when compensatory movements were more pronounced than primary dystonic movements. The best outcome was reported after injections in the forearm muscles. Additional injections in hand muscles were useful in patients with a dystonic flexion in the MCP joints and an extension component in the PIP and DIP joints. Botulinum toxin injections in hand muscles appear to be recommendable only in instrumentalists with little lateral finger motion such as in woodwind players and guitarists (right hand). Keyboard players may benefit from this option when they avoid repertoire requiring a wide hand span and extreme lateral finger motion. Botulinum toxin injections in hand muscles were not successful in musicians who needed to perform lateral finger movements such as in the left hands of one guitarist and of two string players. Musicians with embouchure dystonia and with dystonia affecting the upper arm and shoulder muscles did not benefit from BT treatment (Jabusch et al. 2005).

**Ergonomic changes**

Ergonomic changes were recommended whenever applicable. The aim of ergonomic changes was either a blocking of dystonic movements, for example by
attaching splints to the affected fingers, or circumvention of dystonic movements. This was achieved by modifications of the instrument, e.g. the repositioning of individual keys in woodwind instruments or the replacement of ring keys by plateau keys (Altenmüller 2003). Support systems (belts, stands, tripods) were recommended when the dystonic hand had to carry the instrument while playing such as in oboe, clarinet, and bassoon players. Ergonomic changes were made in 51 patients (35% of all), 32 patients (63% of these) experienced improvement and used the ergonomic changes for an average of 35 months (range 3–125 months). Two patients with embouchure dystonia used an ergonomic aid and reported no improvement. As a conclusion, ergonomic changes should be considered in all patients with limb dystonia. They are not helpful in embouchure dystonia (Jabusch et al. 2005).

**Pedagogical retraining and unspecific exercises**

Pedagogical retraining was applied in patients with all forms of musician’s dystonia. They comprised a variety of behavioural approaches used under the supervision of instructors and they included elements based on the following principles reported previously (Byl and McKenzie 2000; Boullet 2002; Candia et al. 2003; see also Chapter 19):

1. Movements of affected body parts were limited to a level of tempo and force at which the dystonic movement would not occur.
2. Compensatory movements (e.g. of adjacent fingers) were avoided, partially under the application of splints.
3. Instant visual feedback with mirrors or monitors helped patients to recognize dystonic and non-dystonic movements.
4. Body awareness techniques (e.g. Feldenkrais®) were used to increase the patient’s perception of non-dystonic movements.

Pedagogical retraining was given in 24 patients (17% of all), 12 patients (50% of these) experienced improvement. Patients reporting an improvement had undergone this treatment for an average of 28 months (range 3–72 months). Two patients with embouchure dystonia took part in pedagogical retraining and reported no improvement.

Besides the reported therapies recommended by the authors, patients additionally or alternatively performed unspecific technical exercises on their instruments such as are usually practiced by instrumentalists to improve their technique. Seventy-eight patients (54% of all) were practising such unspecific technical exercises, 44 patients (56% of these) experienced improvement. Six out of 11 patients with embouchure dystonia reported an improvement after practising such exercises (Jabusch et al. 2005).
These results provide evidence for the benefit of a behavioural approach, either by pedagogical retraining or by exercises on the instrument. Pedagogical retraining was applied in patients with all forms of musician’s dystonia; however, only patients with limb dystonia improved. More than half of the patients who were practising unspecific exercises reported improvement, among them were six out of 11 patients with embouchure dystonia who applied such exercises. It is noteworthy that the results of these exercises were rated better than those of medical therapies. These positive results may be biased by a particular attitude among musicians and the perceived self-control through exercises. On the other hand positive results of retraining and of exercises underline the benefit of active involvement of patients in the treatment process. At present, the existing behavioural approaches are heterogeneous (Byl and McKenzie 2000; Boullet 2002; Candia et al. 2003). Instrument-specific retraining programmes ought to be elaborated which include the aforementioned principles. All approaches to retraining therapy require the time and patience of affected musicians which seem to be the limiting factors with these therapies. Behavioural aspects, however, should be included in all treatment approaches, at least as an adjunct.

Findings in the light of the literature
In the overall outcome which was recorded on average 8.4 years after onset of symptoms, 71% of patients managed to stay in the musical profession. In other studies, focal dystonia had led to the end of their musical career in more than half of the patients (Schuele and Lederman 2003, 2004). Outcome measures were conducted 13.8 years (string instrumentalists) (Schuele and Lederman 2004) and 8.5 years (woodwind players) (Schuele and Lederman 2004) after onset of symptoms in these reports. The shorter duration of dystonia might be an explanation for the better outcome of our patients group compared with the report on the string players. In the study on woodwind players, the percentage of patients with embouchure dystonia was 25%; in our group it was 13.9%. The generally worse outcome in embouchure dystonia might explain the different outcome after similar durations of dystonia in both studies. In another report 17 out of 33 musicians with focal dystonia had stopped playing at the end of the follow-up period (Brandfonbrener and Robson 2002). The duration of dystonia and total follow-up time were, however, not mentioned, which did not allow a direct comparison. This was also the case in a report on 145 musicians with an average rehabilitation time of 24 months, after which 35 musicians returned to playing in public (Tubiana and Chamagne 2000).

Instrumental students
The subgroup of instrumental students deserve some additional considerations. Focal dystonia is regarded as incurable at present. Although there are some
patients with encouraging follow-up results, therapy remains difficult and requires years and sometimes decades of patience, effort, and stress. Most patients who are at the zenith of their career have no choice and have to undergo treatment in order to improve their situation. Instrumental students, on the contrary, are young and flexible enough to change their profession. In our group, 12 out of 21 affected students changed their profession during the follow-up period. According to our impression, the results of therapy do not justify keeping students busy with treatment attempts over years in the most flexible and productive period of their lives. We conclude that strategies for students with musician’s dystonia should include early support for a change to another profession.

Limitations
Beside of the reported inclusion/exclusion criteria, the choice of treatment was strongly influenced by preferences of patients. The time investment required appeared to influence the choice of treatment. Older patients who desired a quick improvement preferred BT injections. In contrast, several patients found the injection therapy ‘unnatural’ and preferred a retraining therapy. A major limitation of the study was the lack of objective assessment tools for musician’s dystonia which were not available at the beginning of the follow-up. Recently, reliable and precise objective methods have been developed for quantification of musician’s dystonia (Jabusch and Altenmüller 2004; Jabusch et al. 2004b). In future studies such methods will have to be applied for reliable monitoring of treatment effects. Although we were limited in our assessment to a retrospective and subjective rating, several factors may support the validity of our result. Consistent negative results reported by patients with embouchure dystonia after treatment with BT, trihexyphenidyl, and retraining seem to indicate a low placebo sensitivity of musician’s dystonia. Most previous studies observed that a significant number of musicians discontinued treatment within a year if they felt the response did not meet their needs. The adherence seen in our study, with an average treatment duration in responders between 2 and 3 years (and up to 10 years), seems unlikely if the result did not improve their instrumental performance significantly.

Conclusion
Focal dystonia in musicians is still the main challenge in the field of musicians’ medicine. With the available therapies the majority of patients manage to stay in their profession, many of them, however, with substantial compromises. Therapy of patients with embouchure dystonia remains problematic. The available medical approaches are ineffective, and other options have yet to be developed.
There is a pressing need for novel therapies for musician’s dystonia. Several new methods have been described, such as immobilization therapy (Priori et al. 2001; see Chapter 19). These have to be investigated in larger numbers of patients in order to confirm beneficial effects. Behavioural therapies and interdisciplinary strategies combining pharmacological and pedagogical methods are promising, but the different approaches need to be evaluated. Since phenomenological and epidemiological data and results from electrophysiological and follow-up studies imply a behavioural component in the development as well as in the treatment of musician’s dystonia, future research is required to identify ‘beneficial behaviour’ on the instrument. This might, possibly, also be of help for finding strategies with the particular aim of prevention of musician’s dystonia.

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References


