Genetic and therapeutic insights in musician's dystonia:
a single-centre case series and narrative review

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Genetic and therapeutic insights in musician's dystonia:
a single-centre experience of 20 patients with narrative literature review

Abstract

Background: Musician's dystonia is a task-specific focal dystonia that severely impacts professional performance and quality of life. Literature combining clinical data and therapeutic outcomes remains limited.
Objectives: To describe the clinical characteristics, genetic findings, and treatment outcomes in a cohort of musicians with dystonia, and to contextualise these data within current evidence.
Methods: This prospective, monocentric observational study included 20 patients diagnosed with musician's dystonia at a tertiary movement disorder centre (October 2023 – October 2025). Data collected included demographics, instrument type, dystonia phenomenology, targeted genetic testing, and treatments received. Outcomes were assessed both clinically and subjectively.
Results: The cohort comprised 16 males and 4 females (mean age at onset: 38 years). Instruments included keyboards (40%), strings (35%), and wind instruments (25%). Two patients carried *TOR1A* variants. Botulinum toxin injections were performed in 15 cases, with partial improvement in 80%. Sensorimotor retraining was used in 10 patients. Career impact was substantial, with 30% reporting career termination.
Conclusions: Musician's dystonia is heterogeneous and often career-threatening. Our findings highlight the importance of early diagnosis, genetic screening in selected cases, and multimodal management combining botulinum toxin and rehabilitative approaches.

Key words: Focal dystonia – Musician's dystonia – Neurogenetics – Task-specific dystonia – Rare movement disorders

Introduction

Dystonia is a subtype of involuntary hyperkinetic disorder, characterised by abnormal movements or postures of specific body parts, or in some cases, generalised involvement. Some focal forms of dystonia may disappear at rest and emerge only during specific tasks, e.g. writer's cramp [1]. One of the most prevalent focal task-specific dystonia (FTSD) is observed in musicians, commonly referred to as musician's dystonia. The earliest well-documented case in the literature dates to 1830, involving Robert Schumann, who developed pianist's dystonia. Likely influenced by prolonged practice time, overuse, and social pressure, Schumann experienced task-specific muscle contractions affecting his middle finger [2,3]. Other notable cases include pianists Gary Graffman and Leon Fleisher, both of whom publicly shared their struggles with the condition [4]. Musician's dystonia is estimated to affect approximately 1–2% of professional musicians, often with significant consequences for their performance and careers [5].

Diagnosing musician's dystonia is challenging, yet it is essential to differentiate between dystonic traits and compensatory movements, as precise localisation of the dystonic activity is critical for effective treatment. The underlying pathophysiology is complex and multifactorial, involving both intrinsic and extrinsic contributors. Although the genetic basis remains incompletely understood, familial history suggests a potential genetic predisposition or, in some rare cases, a monogenic dystonia [6]. Dysfunctional neuroplasticity, particularly within the sensorimotor system, is frequently implicated, with its manifestation varying according to the instrument played [2]. Moreover, musician's dystonia has been associated with compulsive personality traits and maladaptive practice behaviours, often emerging during musical training [7,8].

Materials and methods

We conducted a prospective, two-year observational study, between October 2023 and October 2025, at the Movement Disorder clinic, Neurology Department, University Hospital of Liege, Belgium. The study included 20 patients diagnosed with musician's dystonia during this period. These patients consisted of a subset drawn from a larger institutional database of hyperkinetic movement disorders, currently under analysis and not yet published. Inclusion criteria were: (i) a diagnosis confirmed by a movement disorder specialist; and (ii) professional or semi-professional musician status.

For each patient, we collected demographics (age, sex, handedness), instrument played, years of practice at onset, practice intensity (hours/day), site and mode of dystonia onset, presence of spread or tremor, loss of task specificity, genetic testing results, treatments attempted (botulinum toxin, retraining protocols), and clinical outcomes.

Genetic testing was performed using a comprehensive Next-Generation-Sequencing (NGS) panel targeting genes associated with movement disorders. In our centre, a movement disorders gene panel is systematically proposed to patients with musician's dystonia, with a diagnostic yield of approximately 14%. The entire exome is sequenced, and data from genes associated with dystonia are bioinformatically extracted to analyse potential variants. When no relevant variant is identified on the targeted panel, exome-wide analysis may be proposed.

Treatment responses were assessed during follow-up visits and based on both clinician judgement (specialist evaluation) and patient-reported outcomes. All patients provided written informed consent for the use of their photographs and videos for scientific purposes.

To compare our cohort with current evidence and contextualise clinical, genetic, and therapeutic findings, we performed a non-systematic review of the literature using PubMed/MEDLINE and Google Scholar with search terms related to musician's dystonia, task-specific dystonia, botulinum toxin, sensorimotor retraining, and dystonia genetics (1980–2025, English only). Relevant original studies, case series, reviews, neurophysiological and genetic articles were included. Additional sources were identified by screening reference lists. As a narrative (non-systematic) review, article selection was based on relevance rather than predefined inclusion criteria.

Results

Twenty patients diagnosed with musician's dystonia were included in the study, representing 4% of all hyperkinetic disorders and 6% of all dystonia cases in our centre. Within focal dystonia, musician's dystonia accounted for 12%. The cohort comprised 16 males and 4 females (male-to-female ratio, 4:1), with a mean age at onset of 31.6 years (range, 11–53 years). Most patients were right-handed (85%), and all were professional or semi-professional musicians. Instrument distribution was as follows: 8 pianists, 5 guitarists, 4 string players (violin, viola, or cello), and 3 wind players. Embouchure dystonia was observed in 4 cases, while focal hand dystonia accounted for most presentations (N = 15). The median number of years of playing at onset was 21, with an average practice intensity of 5.6 hours/day. In 35% of cases, symptom onset was associated with precipitating factors such as intensive practice or the introduction of new repertoire.

Clinically, the most frequent site of onset was the right hand, followed by the left hand and the embouchure. Spread beyond the initial site occurred in 40%, and tremor was present in 25%. Loss of task specificity was documented in 30% of cases.

Genetic testing was proposed to all patients but performed in nine (45%), as several declined further genetic work-up. Among those tested, two individuals carried pathogenic *TOR1A* variants, and one patient presented with a variant of uncertain significance in *NDUFS8*. No other monogenic forms were identified.

Regarding treatment, botulinum toxin (BoNT-A) injections were administered in 15 patients, guided by electromyography (EMG) and ultrasound (US) in most cases. Improvement was reported in 80% of injected patients, although complete remission was rare. Rehabilitation strategies – including sensorimotor retraining, pedagogical approaches, and Musicians' Active Analysis and Repatterning Protocols (MusAARP) – were implemented in 10 patients with variable benefit. The impact on professional activity was considerable: 6 patients reported career termination, while 9 significantly reduced their workload. Detailed demographic and therapeutic data are presented in Table 1 and Table 2.

Discussion

Definition and diagnosis

Among the various forms of focal dystonia – which are characterised by involuntary muscle contractions affecting a single body segment – task-specific movement disorders represent a distinct subset, with symptoms emerging exclusively during the performance of particular activities [1]. These include well-recognised entities such as writer's cramp, typing-related dystonia, and musician's dystonia. The latter involves involuntary contractions of highly trained muscles specifically engaged during instrumental performance. Several forms of musician's dystonia have been identified, each corresponding to the specific motor demands of the instrument played. Instrumentalists who rely heavily on fine motor control of the hands – such as guitarists, violinists, and pianists – may develop a focal hand dystonia, commonly referred to as musician's cramp. Rare cases of lower limb involvement have also been described, for example in percussionists [9]. In contrast, wind and brass players are more prone to embouchure dystonia, a form that affects the muscles involved in facial, oral, and cervical control required for breath and tone production [2]. In some cases, musician's dystonia may gradually lose its task-specific nature and extend to other motor activities, leading to segmental involvement or persistent dystonic posturing even outside of musical performance, such as typing or handling cutlery [10,11]. Figure 1 illustrates selected clinical cases from our cohort, highlighting phenotypic diversity.

In our clinic, 20 patients with musician's dystonia currently account for 4% of all hyperkinetic disorders and 12% of focal dystonia, consistent with the Hannover Epidemiology Study reporting ~5% across dystonia subtypes [12]. A clear male predominance is observed (sex ratio ~ 4:1), potentially reflecting behavioural and psychological risk factors more prevalent in men, such as perfectionism, anxiety, and intensive practice routines [10,13,14]. Several studies have shown a higher risk of dystonia in musicians with extensive childhood practice, particularly for instruments demanding fine motor control [8].

Pathophysiology

The pathophysiology of musician's dystonia remains partially understood. It may involve dysfunctions in the basal ganglia and other sensorimotor networks, typically affecting highly trained musicians during the execution of specific, highly refined motor tasks [2]. Several contributing factors have been identified, including genetic predisposition, physical issues (e.g., repetitive strain, nerve compression), and psychological traits such as perfectionism, anxiety, frustration. These psychological factors may trigger and/or exacerbate the condition but are not always present [2,15–17].

Some theories suggest that abnormal neuroplasticity in the sensorimotor cortex plays a central role, with irregularities in cortical inhibition, sensory processing, and motor control [18–20]. Repetitive strain and fatigue may further disrupt normal movement patterns, leading to maladaptive motor strategies, such as co-contraction or incoordination of wrist flexors and extensors in pianist's dystonia [21,22]. Symptoms typically appear in the most solicited body segment during performance, such as the embouchure for brass players or the right hand for pianists [23]. Research also suggests that musical training and genetic predisposition can influence interhemispheric inhibition, pointing to a neuroplastic mechanism shaped by both genetics and experience [24,25]. Moreover, cerebellar involvement – particularly through overactivity and altered networks – may play a role in generating the abnormal motor patterns seen in musician's dystonia [26,27].

The role of genetic predisposition has been suggested in the past, as around 10% of affected musicians report a family history of dystonia [10,16]. Moreover, individuals with a family history for other movement disorders also had an increased risk of developing musician's dystonia [28]. Monogenic aetiologies of musician's dystonia primarily involve DYT-*TOR1A*, particularly the typical GAG deletion in *TOR1A*, which accounts for ~0.5% of all musician's dystonia cases [29]. In our cohort, 2 individuals were diagnosed with DYT-*TOR1A*. The remaining 7 cases, with no pathogenic variants identified to date, are currently considered sporadic (Figure 2). Other isolated forms of dystonia that may present as musician's dystonia are associated with *ANO3, AIF2AK2, GNAL, HPCA, KMT2B, PRKRA, THAP1, VPS16,* and *AOPEP,* respectively [30]. Additional loci, such as DYT7 locus [31] and *RAB12* [32] have been reported in association with musician's dystonia. However, in most patients with focal dystonia – including musician's dystonia – no genetic cause has yet been identified [30]. Another factor that may explain the heritability of musician's dystonia is a genetic predisposition linked to variants distributed throughout the genome, rather than a specific gene as seen in monogenic forms. To date, one genome-wide association study has been conducted to identify potential genetic risk factors for musician's dystonia. This study reported the rs11655081 variant in *ARSG* as potentially associated with musician's dystonia [33]. Although no causative disease variant has been identified in this gene, its association with task-specific dystonia and musician's dystonia has been confirmed [34]. Nevertheless, no common variants with a significant effect size have been identified to date [33]. Larger patient cohorts are required to further elucidate the genetic risk factors involved [16,32,33,35].

Psychological factors also appear to play a significant role. Many affected musicians report high levels of anxiety, perfectionism, emotional neglect and social phobia [15,36,37]. These traits – more prevalent in men – may not only increase susceptibility but also influence disease progression, as personality characteristics can have a lasting impact on motor control [14,38]. Emotional stress, particularly performance-related pressure, may activate the amygdala and reinforce maladaptive motor patterns in the brain [2].

Finally, musician's dystonia seems to affect certain instruments and musical genres more than others. Classical musicians – especially pianists and violinists – are more frequently affected than jazz performers [39]. This may be due to the rigid technical demands of classical music, where precision is paramount and interpretative freedom is limited. Unlike jazz or pop, where improvisation is encouraged, classical performance often involves strict adherence to stylistic norms and intense scrutiny, both from the performer and the audience. This high-pressure environment may increase the risk of developing dystonia [2].

Investigations

Historically, the diagnostic approach to musician's dystonia was mainly clinical, relying on symptom observation which were often misattributed to stress, fatigue, musculoskeletal conditions or psychological causes [10,13]. Nowadays, a thorough neurological examination by a specialist remains fundamental, particularly one familiar with movement disorders and the unique motor demands of musical performance, as there are no biomarkers of this condition. Indeed, brain magnetic resonance imaging (MRI), biological and electrophysiological findings are usually unremarkable [6,39].

Simulation of instrument playing during assessment, or when possible, playing the actual instrument, is often necessary to elicit dystonic symptoms, which may be absent during routine physical examination [39]. The presence of sensory tricks – temporary relief of symptoms through altered somatosensory input, such as playing with a latex glove – further supports the diagnosis and highlights the role of sensorimotor integration [2,13,40]. Classification of musician's dystonia according to the instrument and affected body part is now standard, with embouchure dystonia requiring particular attention due to its overlap with neuro-otological symptoms such as velopharyngeal incompetence and involuntary lip movements [10,41].

Even if only a small proportion of genetic forms of dystonia is currently known, genetic testing remains a key element in the diagnostic process and patient follow-up. The absence of a family history in isolated dystonia is not an argument against a genetic aetiology as more than 70% of cases are isolated [30]. An earlier onset and rapid progression to non-musician tasks are red flags for genetic dystonia [35]. Importantly, some autosomal dominant dystonias show better response to specific treatments, such as DYT-*TOR1A* or DYT-*SGCE* to deep brain stimulation (DBS) [42,43]. In addition, finding a genetic diagnosis can lead to genetic counselling, which is the process of informing the patient about the risk of disease transmission and the procedures currently available to deal with this risk (e.g. preimplantation genetic diagnosis) [44]. Finally, a genetic diagnosis is required for inclusion in specific clinical trials. The most frequent genetic causes identified in patients with late-onset focal dystonia are DYT-*TOR1A*, DYT-*THAP1*, DYT-*ANO3* and DYT-*GNAL* [45]. A first-line genetic testing approach would be to start with these gene-specific tests. However, the diagnostic rate of gene-by-gene testing is very low (~6%) and time-consuming [46]. NGS has made it possible to sequence multiple genes in parallel, reducing both cost and time [47]. A dystonia-related gene panel is a more suitable option for genetic screening in dystonia, with a diagnostic rate reaching approximately 15–20% [46,48]. Whole exome sequencing appears to have a higher yield, up to 25-35% [49,50]. However, whole genome sequencing, especially based on short-read sequencing, has shown only 8% of additional diagnoses, which could be considered insufficient given the significantly increased cost [51,52]. In clinical practice, we recommend a targeted gene panel derived from exome data. Collaboration between neurologists and neurogeneticists is increasingly recommended to interpret complex genetic data and integrate it into clinical decision-making.

Finally, interdisciplinary assessment involving neurologist, oto-rhino-pharyngologist and speech therapist is particularly relevant for brass and woodwind players exploration, where embouchure dystonia may manifest with symptoms affecting speech, eating, or airflow control [10,21].

Treatment and prognosis

Pharmacological treatment for musician's dystonia has shown limited efficacy. Trihexyphenidyl (Artane), an anticholinergic agent, has historically been used, particularly in limb dystonia, but its benefits are limited and often outweighed by systemic side effects such as sedation, dry mouth, and cognitive impairment [53,54]. Other oral agents, including anticonvulsants and muscle relaxants, have similarly modest outcomes and are poorly tolerated, making them secondary options [10].

In contrast, BoNT-A injections represent the gold standard for symptomatic management of FTSD. Inducing chemodenervation at the neuromuscular junction, BoNT-A reduces involuntary contractions while preserving functional control [55–57]. The precision of injection is critical, and recent advances in dual guidance techniques – combining EMG and US – have significantly improved targeting accuracy, reduced side effects, and enhanced therapeutic outcomes. US guidance is particularly valuable in forearm muscles, allowing real-time visualisation of both target and adjacent structures [54,58].

Surgical options, such as ventro-oral thalamotomy, are rarely indicated but may be considered in refractory cases. Emerging evidence suggests long-term efficacy and safety in selected patients, with high response rates and low complication profiles [54,59]. As for magnetic resonance-guided focused ultrasound thalamotomy, favourable outcomes have been reported in a case series of focal hand dystonia, with one case report by Horisawa et al. about musician's dystonia [60,61].

The rehabilitative approach has gained increasing recognition, especially in cases where pharmacological or surgical interventions are insufficient. Sensorimotor retraining, often structured in phases of deprogramming, motor re-education, and reintegration of technique, has demonstrated promising results, particularly in pianists and guitarists [62,63]. Off-instrument retraining protocols, such as MusAARP, offer psychological benefits by reducing performance anxiety and enhancing self-efficacy [64]. Multimodal rehabilitation strategies – including sensory-motor retraining, slow-down exercises, and behavioural therapies – are increasingly favoured, especially when tailored to individual needs and supported by collaboration between therapists, educators, and clinicians [7,63].

In our cohort, treatment outcomes mirrored these heterogeneous therapeutic responses. BoNT-A injections provided partial but meaningful improvement in 80% of treated patients, consistent with published efficacy rates for focal task-specific dystonia [54]. Most patients reported reduced involuntary contractions and improved technical control, although complete remission was uncommon, highlighting the limitations of BoNT-A in highly skilled motor tasks [56]. Rehabilitation strategies – including sensorimotor retraining, pedagogical approaches, and MusAARP protocols – yielded variable yet clinically relevant benefits in approximately half of the patients who undertook them, particularly in individuals motivated to engage in prolonged, structured retraining. Importantly, none of the patients in our series underwent DBS or lesional procedures.

Recent work has also highlighted the role of emotional factors in therapeutic approaches. Grifoni et al. (2024) emphasise that addressing emotional trauma may be an important component of modern management, although robust evidence remains limited [65]. Likewise, the evidence supporting neuromodulation techniques in musician's dystonia is still weak and inconsistent, and our cohort did not include patients treated with these modalities [65,66].

The prognosis of musician's dystonia remains highly variable and often discouraging, particularly in professional performers [67]. Long-term follow-up studies indicate that a significant proportion of affected musicians are forced to abandon their careers due to persistent motor impairment [68]. Embouchure dystonia, in particular, is associated with poorer outcomes and higher rates of career termination [39]. Although various therapeutic strategies exist, only a minority of patients regain near-normal motor control [2].

Limitations

This study has several limitations inherent to its design. First, it is a monocentric case series conducted in a tertiary movement disorders centre, which may introduce referral bias and limit the generalisability of the findings. The sample size is modest, as is typical for musician's dystonia, and the absence of a control group precludes causal inference. Clinical outcomes were assessed using a combination of specialist judgement and patient-reported improvement, without the use of standardised quantitative scales, which may affect comparability with other studies. In addition, no formal psychological assessment was performed, and psychological traits frequently discussed in the literature cannot be quantified in our cohort; we nevertheless report precipitating factors and practice behaviours when these were mentioned by patients. Furthermore, although most patients were offered genetic testing, a proportion declined, which may underestimate the genetic contribution in this cohort. Finally, the lack of patients treated with DBS or lesional procedures reflects both the rarity of surgical indications and local practice patterns, but limits the discussion of surgical outcomes. These findings should therefore be considered exploratory and hypothesis-generating, requiring confirmation in larger multicentre cohorts.

Conclusion

Musician's dystonia is a multifaceted and still poorly understood condition that poses significant challenges for both clinicians and performers. Its task-specific nature, combined with the diversity of clinical presentations across instruments, calls for a personalised and interdisciplinary approach to diagnosis and care. Through this case series, we provide a detailed clinical, genetic, and therapeutic characterisation of 20 patients, offering real-world insights that complement the existing literature. Our observations reinforce the heterogeneous nature of musician's dystonia and highlight the frequent impact on professional activity.

Although the pathophysiology remains only partially elucidated, current evidence points to a convergence of genetic susceptibility, maladaptive neuroplasticity, and psychological traits such as perfectionism and performance anxiety. Diagnostic strategies have evolved beyond clinical observation, now integrating targeted neurological and rhino-pharyngological assessments, along with genetic screening in selected cases.

Treatment outcomes in our series illustrate the current therapeutic landscape: botulinum toxin injections, when guided by EMG and US, frequently provides partial symptomatic relief. Oral medications offer limited benefit, and surgery is reserved for exceptional and refractory cases. Rehabilitative approaches – particularly pedagogical retraining and multimodal sensorimotor therapy – show promise in restoring motor control and supporting psychological well-being, helping musicians regain confidence and artistic identity. These findings underscore the importance of individualised, multimodal care, while also illustrating the therapeutic limitations many patients still face. Despite these advances, the long-term prognosis remains guarded. Many musicians are unable to return to their previous level of performance, and some are forced to abandon their careers altogether.

Given the observational nature and limited sample size of this study, the conclusions drawn are exploratory and hypothesis-generating. Larger, longitudinal, multi-centre studies are required to better define genetic risk factors, clarify instrument-specific phenotypes, and develop more effective rehabilitative and neurophysiological interventions. Continued collaborative work between clinicians, therapists, educators, and musicians is essential to advance understanding and improve outcomes for individuals affected by this disabling condition.

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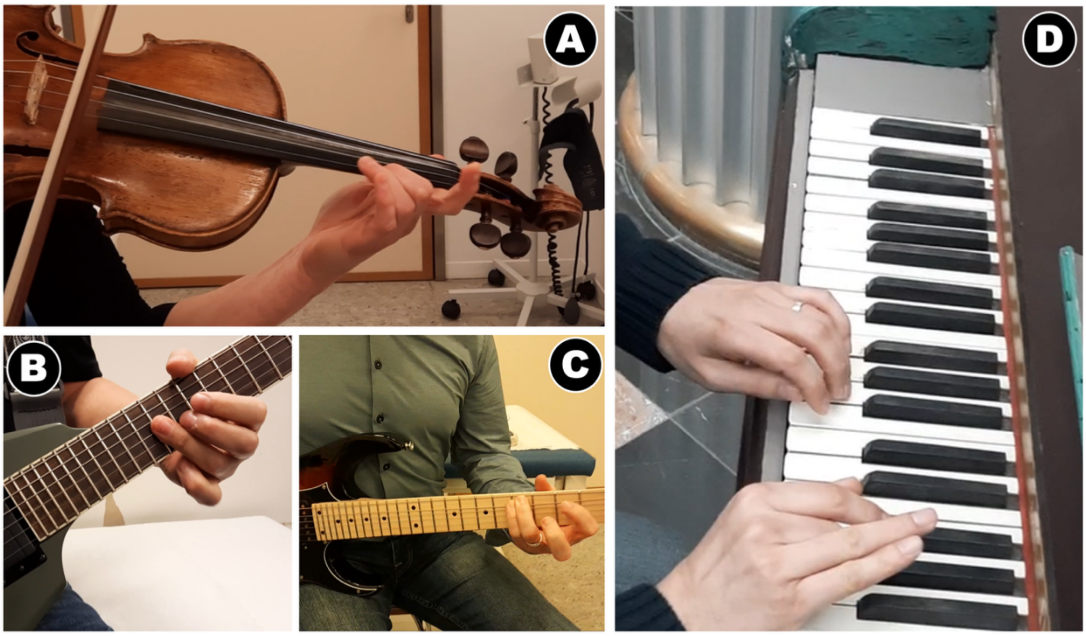
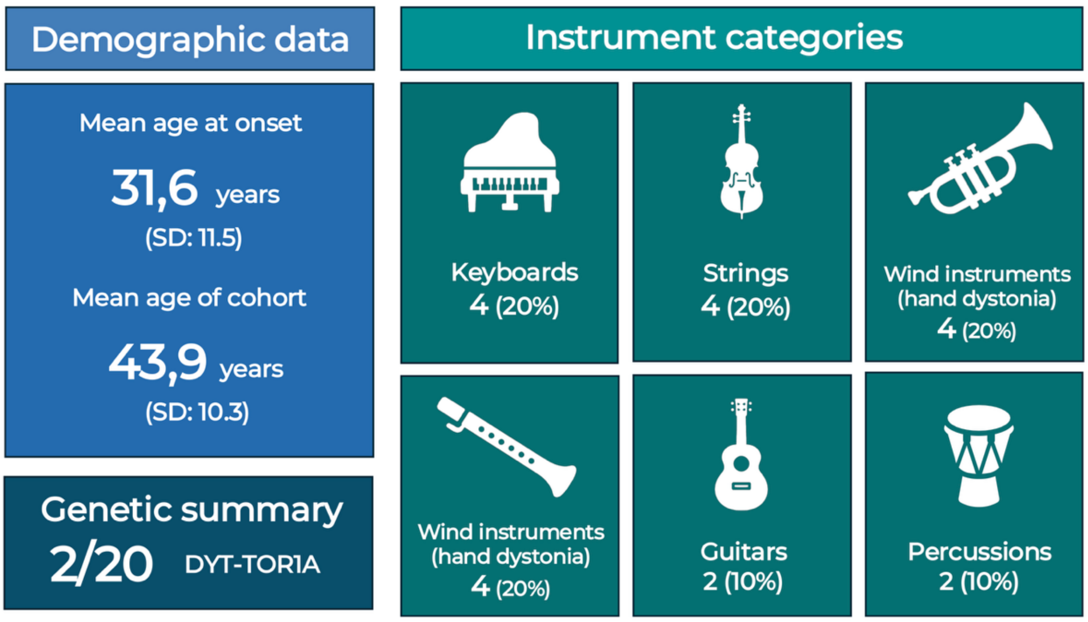
Legends of the figures

- **Figure 1**: **Clinical presentation of dystonic traits during musical performance**. **(A)** Left-hand dystonia in a violinist, characterised by involuntary extension of the second digit (primarily at the metacarpophalangeal and proximal interphalangeal joints) and hyperflexion of the third digit (proximal and distal interphalangeal joints) during performance. **(B)** Uncontrollable excessive flexion of the fifth digit of the left hand in a guitarist. **(C)** Dystonia in a guitarist's left hand, showing involuntary adduction of the fourth and fifth digits, with the fifth digit positioned beneath the fourth, impairing fluidity of movement. **(D)** Hyperflexion of the third digit of the right hand in a pianist, associated with the extension of the fourth and fifth digits.



- **Figure 2**: **Overview of the cohort of musician's dystonia patients evaluated at the University Hospital of Liege (Belgium).**
This figure illustrates the clinical distribution of dystonia types among professional musicians, as well as the results of the genetic investigations performed. Instruments were grouped into six categories: *Keyboards*, *Strings*, *Wind instruments with hand dystonia*, *Wind instruments with embouchure dystonia*, *Guitar*, and *Percussion*. Percentages indicate the proportion of patients in each category.



- **Table 1 – Patient characteristics**

Patient ID	Age	Age at onset (years)	Sex	Handedness	Instrument	Years playing at onset	Practice hours/day at onset	Onset site	Spread	Tremor	Loss of task specificity	Genetic result	Career impact
#001	46	38	M	R	Pianist, accordionist	21	4	Right hand	Yes	No	Yes	Negative	Career ending
#002	36	22	F	R	Saxophonist	14	8	Embouchure	Yes	Yes	No	*TOR1A*	Reduced workload
#003	52	42	M	R	Guitarist	24	9	Left hand	No	No	No	Negative	Reduced workload
#004	47	27	M	R	Pianist	11	11	Right hand	Yes	No	No	NA	Career ending
#005	21	15	M	L	Pianist	9	5	Right hand	Yes	No	No	Negative	Reduced workload
#006	31	27	M	R	Clarinettist	19	4	Left hand	No	No	No	Negative	Reduced workload
#007	23	20	M	R	Hautboist	12	6	Right hand	No	No	No	NA	Reduced workload
#008	54	38	M	R	Guitarist	27	6	Left hand	Yes	No	Yes	Negative	Reduced workload
#009	56	53	M	R	Clarinettist	32	7	Embouchure	Yes	No	Yes	Negative	Career change
#010	53	11	M	L	Violinist	4	5	Right hand	Yes	Yes	Yes	*TOR1A*	Career ending
#011	54	47	F	R	Violist	21	6	Cervical	Yes	Yes	Yes	VUS *NDUFS8*	NA
#012	45	38	F	R	Cellist	35	7	Left hand	No	No	No	Negative	Reduced workload
#013	49	41	M	R	Cellist	30	6	Left hand	No	No	Yes	NA	Career ending
#014	46	35	M	R	Percussionist	20	2	Right hand	Yes	Yes	No	Negative	Career change
#015	48	38	F	L	Pianist	32	5	Left hand	Yes	No	No	Negative	Reduced workload
#016	54	23	M	R	Percussionist	12	4	Left hand	Yes	No	Yes	NA	Career change
#017	34	31	F	R	Flutist	23	6	Left hand	No	No	No	NA	Reduced workload
#018	44	24	F	R	Saxophonist	9	4	Embouchure	No	Yes	No	NA	NA
#019	50	44	M	R	Trumpetist	41	6	Embouchure	Yes	No	No	Negative	Career ending
#020	35	19	F	L	Flutist	14	5	Left hand	Yes	No	No	NA	Reduced workload

Legend: Demographic and clinical characteristics of the 20 musicians included in this monocentric case series. Age = current age at evaluation; Age at onset = age at first symptom; R = right; L = left; VUS = variant of uncertain significance; NA = not available.

- **Table 2 –Treatments and outcomes**

Patient ID	BoNT performed	BoNT guidance	BoNT target muscles	BoNT response	Retraining protocol	Retraining response	Overall outcome
#001	No	NA	NA	NA	Sensorimotor	NA	Worse
#002	Yes	EMG	Masseter, temporal	Improved	Sensorimotor	Improved	Improved
#003	Yes	EMG, US	Flexor digitorum profondus, interosseous	NA	NA	NA	Improved
#004	No	NA	NA	NA	Pedagogical	No change	Worse
#005	No	NA	NA	NA	Pedagogical, sensorimotor	NA	Stable
#006	No	NA	NA	NA	MusAARP	Improved	Improved
#007	No	NA	NA	NA	Pedagogical	No change	Worse
#008	Yes	EMG, US	Flexor digitorum profondus	Improved	Sensorimotor	No change	Stable
#009	No	NA	NA	NA	Logopedic, sensorimotor	No change	Worse
#010	No	NA	NA	NA	NA	NA	Worse
#011	No	NA	NA	NA	Sensorimotor	Improved	Improved
#012	No	NA	NA	NA	Sensorimotor, MusAARP	Improved	Stable
#013	Yes	EMG, US	Flexor digitorum profondus	NA	Pedagogical	NA	NA
#014	No	NA	NA	NA	NA	NA	Improved
#015	No	NA	NA	NA	MusAARP	NA	Stable
#016	Yes	EMG, US	Flexor carpi ulnaris, flexor carpi radialis	Improved	NA	NA	Stable
#017	No	NA	NA	NA	MusAARP, pedagogical	Improved	Improved
#018	No	NA	NA	NA	Sensorimotor	Improved	NA
#019	No	NA	NA	NA	Sensorimotor	No change	Worse
#020	Yes	EMG, US	Extensor digiti minimi, extensor digitorum	Improved	NA	NA	Improved

Legend: Overview of the treatments administered and outcomes in the 20 musicians included in this monocentric case series. BoNT = botulinum toxin; EMG = electromyography; US = ultrasound; MusAARP = Musicians' Active Analysis and Repatterning Protocol; NA = not available.

- **Video 1**: **Various clinical presentations of musician's dystonia, admitted in the Movement Disorder Department of the University Hospital of Liege (Belgium)**.
  - **Segment 1 – Pianist:** 46-year-old male patient (age at onset: 38). Dystonic features affecting the right hand, predominantly the middle finger, and characterised by unvoluntary flexion at both proximal and distal interphalangeal joints, with milder involvement of the ring finger.
  - **Segment 2 – Cellist:** 45-year-old female patient (age at onset: 38). Dystonic features affecting the left hand while playing the violin, characterised by unvoluntary and excessive flexion of the left middle finger when pressing the string, with insufficient release, combined with inappropriate extension of the index finger, possibly compensatory.
  - **Segment 3 – Percussionist:** 46-year-old male patient (age at onset: 35). Task-specific focal dystonia of the right hand, manifesting as unvoluntary flexion at the metacarpophalangeal joints combined with extension of the interphalangeal joints of digits 2 to 5 as soon as he mimics playing the djembe on a desk.
  - **Segment 4 – Saxophonist:** 36-year-old female patient (age at onset: 22). In this video, she is playing only with the embouchure of her saxophone, and presents with embouchure dystonia, characterised by oromandibular movements as soon as she tries to produce and maintain a constant note.

Author contributions

- Idea for the article, initial draft creation: FD
- Literature search: DA, CM, FD
- Data analysis: DA, CM, FD
- Draft writing: DA
- Critical revision: CM, FD
- Figures and video: DA, FD