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Dystonia and pre/post-performance body maintenance among high-speed stringed instrument players: A pilot study

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Abstract

There are likely numerous professional musicians who have not been diagnosed with Focal task specific dystonia, but nonetheless experience hand and muscle tension accompanied by a loss of motor control during performance. As such, it is important to implement preventative measures before performance begins to suffer. The proportion of all musicians who fall into this category is unclear. This study aims to investigate the proportion of musicians who suffer from dystonia and/or have motor difficulties during performance. This study also aims to investigate the prevalence of maintenance efforts by professional musicians after rehearsal practice. 76 professional high-speed stringed instrument players and 70 non-musicians with no performance experience were included in a study of dystonia and pre/post-performance body maintenance. Musicians experienced significantly more dystonia compared to non-musicians. Performers who implemented post-practice and post-performance body maintenance experienced less dystonia than those who did not. These results suggest that soft tissue maintenance of the hands and upper extremities following musical performance serve as a preventative measure for Focal Task-Specific Dystonia.

Keywords: Dystonia; Musician; Muscle Tone; Hand

1. Introduction

According to the National Census conducted by Japan's Ministry of Internal Affairs and Communications (2020), there are approximately 110 thousand professional musicians in Japan¹. A commitment of 10,000 hours of practice over a period of 10 years starting from childhood is required to reach the high level of technical skill demanded of professional musicians², and research indicates that enlargement of the cerebral sensorimotor cortex, the region of the brain that controls finger movement, along with other neuroplastic changes take place to allow for repeated, long-term, and accurate practice³. Nonetheless, such practice can lead to Focal Task-Specific Dystonia (FTSD), which affects 1% of professional musicians⁴.

FTSD among musicians has been found to arise from irregular activity in the motor cortex and basal ganglia^{5,6}.

FTSD is caused by the rhythm and timing of musical scores as well as the long-term practice of a discipline that demands a faithful reproduction of strength without any degree of freedom⁷. Other primary causes include the extended endurance of pain and muscle fatigue during performance, and the subsequent irregular centripetal path of sensory input^{8,9}. Additionally, psychological factors such as the tendency for anxiety and a perfectionist mindset¹⁰, as well as genetic factors¹¹ have also been reported.

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Treatments for FTSD include drug therapy¹²⁾, botox injection¹³⁾, physical and occupational therapy^{14,15)}, and even stereotactic neurosurgery¹⁶⁾, which temporarily relieves symptoms. There is no permanently effective treatment, nor have any preventative measures been established. There are likely numerous professional musicians who have not been diagnosed with FTSD, but nonetheless experience hand and muscle tension accompanied by a loss of motor control during performance. As such, it is important to implement preventative measures before performance begins to suffer. The proportion of all musicians who fall into this category is unclear. The first author of this study conducted an added hand/finger exercise routine with cellists suffering from dystonia during practice and after performances as an approach to normalize muscular tension. This approach led to alleviation of dystonia symptoms¹⁷⁾, although there is the possibility that the musicians were not doing the stretches and other maintenance efforts following performance rehearsal. The present study encompasses preliminary research on preventative measures. Specifically, this study aims to investigate the proportion of musicians who suffer from dystonia and/or have motor difficulties during performance. This study also aims to investigate the prevalence of maintenance efforts by professional musicians after rehearsal practice. A non-musician group is used as the control in this study of high-speed stringed instrument players. Herein, we estimate the latent number of pre-FTSD musicians and evaluate preventative measures.

2. Methodology

Musician participants (referred to below as the musician group) were selected based on association with a Japanese music university or professional orchestra, and specialization in the high-speed stringed instruments violin, viola, or cello. Exclusion criteria included prior dystonia diagnosis. Musician group participants were recruited using a mailed study request sent to music universities and orchestras. Of the orchestras that sent back their study request, those that agreed to participate in the study were contacted by the second author. The study was then explained to the participant, and written consent was obtained. Afterwards, the survey was conducted at the second author's office, or in a private room provided by the music university/orchestra.

Non-musician control participants (referred to as the non-musician group) were selected based on the criteria of no experience in musical performance. Exclusion criteria included occupation that demands a high degree of finger activity (keyboard, typewriter, jobs that involve writing, etc.), and was adjusted such that there was no statistical difference with the musician group with respect to age, group size, or gender. Participants acquainted with the second author were sent requests to participate.

Musicians were presented with;

- The Modified Ashworth Scale (MAS) to evaluate dystonia due to extrapyramidal irregularity,
- Questions pertaining to muscle issues, tension, or other symptoms affecting physical performance, and
- Questions about whether or not they engage in any upper arm/hand stretching, massage, or other maintenance efforts before or after rehearsal or performance.

The non-musician group questions only included the MAS evaluation of dystonia. Additionally, gender, age, and handedness were inquired about. For musicians, instrument type and performance history were also collected.

Moreover, to evaluate those with pre-dystonia due to extrapyramidal dysfunction, the MAS was used to evaluate muscle tension irregularity. However, MAS alone was insufficient for this aim. The pathophysiological mechanism of this phenomenon involves irregular activity between the sensorimotor cortex and the basal ganglia loop as well as overactivity of the sensorimotor cortex and projections of the reticular formation¹⁸⁾. The present study's methodology selects for participants with dystonia. MAS evaluates the presence of catching when target fingers II through V are simultaneously and quickly extended from a flexed position. This is intended to target the high-speed action of the fingers of the left hand.

Statistical analysis of the prevalence of dystonia between the musician and non-musician groups was performed using the Mann-Whitney U test.

The correlation between dystonia, motor difficulty, and performance of maintenance activities was investigated. Dystonia was treated as the explanatory variable, and other factors were regarded as independent variables under stepwise regression analysis, yielding a multiple regression equation. The statistical software used for analysis were the data analysis system EXSAS ver. 7.5 for Windows and STATCEL ver. 2 for Windows. Furthermore, analyzed data underwent member checking via instructions provided to research participants.

The present study also anonymizes and avoids collecting data for reasons outside the scope of the study out of ethical considerations. Participants were able to exit the study at any time, and consent could be withdrawn along with study exit with no consequences for the participant. This was explained both verbally and in writing. Moreover, this study was approved by the Ethics Committee at Shonan University of Medical Sciences (Approval No. 19-016).

3. Results

The musician survey was conducted at 17 music universities and orchestras, and 76 high-speed stringed instrument musicians participated. 70 non-musicians also participated. Among the participating musicians, 39 (51.3%) were male, 37 (48.7%) were female, max. age was 72, min. age was 27, and mean age was 44.4 ± 10.7 . 69 (90.8%) musicians were right-handed, and 7 (9.2%) were left-handed. 35 played violin, 4 played viola, and 37 played cello. The longest musician career was 67 years, the shortest was 22 years, and mean career length was 39.1 ± 10.7 years. Regarding affiliation, 17 were soloists, and 59 were tutti musicians. Among the non-musicians, 35 (50%) were male and 35 (50%) were female. Max. age was 70, min. age was 22, and mean age was 43.7 ± 11.3 . 65 were right-handed and 5 were left-handed.

3.1. MAS dystonia evaluation results.

Analysis of dystonia among musicians revealed 23 (30.3%) normal and 53 (69.7%) irregular. Among non-musicians, 64 (94.3%) were normal and 4 (5.7%) were irregular (irregularity among both groups: musicians>non-musicians; $P=0.001$). All labels of “irregular” were by MAS level of 1, which indicates momentary feelings of catching. The breakdown of musicians with dystonia are as such: 34 (64.2%) male, 19 (35.8%) female, (male:female ratio: $P=0.06$), 49 (92.5) right-handed, and 4 (7.5%) left-handed. By instrument, 25 (71.4%) were violinists, 4 (100%) were violists, and 24 (64.9%) were cellists.

3.2. Motor Difficulty

Among musicians, 5 indicated motor difficulty, all of whom were in the dystonia subgroup (irregularity inter-group comparison: $P=0.13$). By instrument, 2 played cello and 3 played violin. Participants complained of involuntary motor activity during performance when playing a trill (musical flourish involving playing notes on two neighboring strings alternately at high speed) and/or vibrato.

3.3. Implementation of Maintenance

Among musicians, 51 (67.1%) performed maintenance before rehearsal and performance, while 25 (32.9%) did not. 6 musicians (7.9%) performed maintenance after rehearsal and performance, while 70 (92.1%) did not (maintenance performed before vs. after rehearsal and before vs. after performance: $P=0.001$). Breakdown of the 6 musicians who performed maintenance revealed 1 with dystonia and 5 with normal muscle tension ($P=0.003$).

4. Discussion

This study examined dystonia among non-musicians and professional high-speed stringed instrument musicians, finding a significantly greater rate of dystonia among professionals compared to non-musicians. A decrease in cortical inhibition has been found among dystonia patients¹⁹⁾, making it likely that many high-speed stringed instrument players may suffer from asymptomatic cortical inhibition impairment. 1% of musicians are reportedly affected by focal dystonia⁴⁾, and there are likely numerous pre-FTSD musicians currently active. However, there is no correlation between involuntary finger movement during performance/other motor issues and dystonia, and further research is required to elucidate whether or not dystonia predisposes musicians to FTSD. The present study found that musicians who implemented bodily care measures following practice and performance were less likely to experience dystonia than those who did not. Moreover, it was found that most performers did not conduct body maintenance after practice and/or performance. Other studies indicate that dystonia patients experience irregular function of the sensory cortex²⁰⁾, and continued playing through pain is a potential latent trigger of dystonia^{8,9)}. In fact, continued palliative care for pain associated with FTSD among stringed instrument musicians lessens symptoms of dystonia. Results from the present study indicate that soft tissue maintenance of the hands and upper extremities before and after musical performance may serve to prevent FTSD.

5. Conclusion

Musicians experienced significantly more dystonia compared to non-musicians. Performers who implemented post-practice and post-performance body maintenance experienced less dystonia than those who did not. These results

suggest that soft tissue maintenance of the hands and upper extremities following musical performance serve as a preventative measure for Focal Task-Specific Dystonia.

Compliance with ethical standards

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Disclosure of conflict of interest

No Conflict of interest.

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