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Changes in motor function in Duchenne muscular dystrophy patients after travel restrictions due to COVID-19

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Abstract

Introduction/Aim: This retrospective study aimed to quantify the changes in motor function in patients with Duchenne muscular dystrophy (DMD) due to the government-imposed travel restrictions associated with the coronavirus disease 2019 (COVID-19) pandemic.

Methods: Twelve DMD patients were enrolled in this investigation (mean ± SD age: 9.8 ± 3.6 y). Their physical characteristics and motor function were evaluated approximately 3 mo before, immediately before, and approximately 3 mo after the travel restrictions were decreed. Statistical comparisons were performed of the changes in motor function before and after the travel restrictions.

Results: The change in range of motion (ROM) of ankle dorsiflexion was significantly decreased after the travel restrictions. Changes in body mass index and other motor function parameters were not significant.

Discussion: An apparent decrease in the amount of physical activity due to travel restrictions in response to COVID-19 negatively affected ankle dorsiflexion ROM but not other motor functions. A more sedentary lifestyle and lack of regular physical therapy services most likely contributed to this reduction. The use of remote rehabilitation tools with the involvement of physiotherapists may help mitigate such changes and prevent more severe physical decline.

KEYWORDS
contracture, COVID-19, Duchenne muscular dystrophy, motor function, travel restrictions

Abbreviations: BMI, body mass index; COVID-19, coronavirus disease 2019; DMD, Duchenne muscular dystrophy; NSAA, North Star Ambulatory Assessment; PT, physical therapy; ROM, range of motion.

1 | INTRODUCTION

Coronavirus disease 2019 (COVID-19) is caused by severe acute respiratory syndrome coronavirus-2.[1] In response to this global public health crisis, the government of Japan declared a nationwide state of emergency on April 16, 2020. According to the announcement made by the Ministry of Education, Culture, Sports, Science and Technology of Japan on April 22, 93% of all public schools were closed, and entertainment and restaurant activities were suspended at the request of prefectural governments. Moreover, citizens were asked to refrain from leaving their homes except for urgent needs.

Duchenne muscular dystrophy (DMD) is a progressive inherited muscular disease[2] that requires moderate exercise to maintain adequate muscle and cardiopulmonary function.[3,4] Maintaining standing ability and preventing ankle joint deformities are also important for the retention of walking function in DMD.[5,6] However, all outpatient treatments were canceled at our hospital from April 7 to June 30, 2020, due to COVID-19. During that time, our DMD patients' lifestyles were largely sedentary, with a lack of regular physical therapy (PT) services. Fixation of the limbs in the same posture can lead to joint contractures,[7] that may worsen from a prolonged decrease in the amount of exercise.

This study aimed to quantify the changes in motor function in DMD patients due to the government-imposed travel restrictions in response to the COVID-19 epidemic and investigate the effects of decreases in exercise and normal PT services. Understanding the alterations in motor function in DMD will shed light on the risks during similar travel restrictions, which may be of use when designing plans for PT at locations remote from the usual PT centers.

2 | METHODS

This retrospective observational study was conducted in our hospital rehabilitation department between January 17 and August 3, 2020. Patients who received at least two PT services between January 17 and April 7 and at least one PT service between June 30 and August 3 were included. Data were extracted from medical records at three time points: approximately 3 mo before, immediately before, and approximately 3 mo after the government decree of travel restrictions.

2.1 | Patients

We retrospectively enrolled 12 ambulatory patients with DMD. Soon after the declaration of travel restrictions, we advised the patients to maintain a standing time of approximately 30 min daily and stretch their lower-leg tendons once or twice a day. We examined body mass index (BMI) and motor function (dorsiflexion range of motion [ROM] of both ankles, 10 m running time, rising from the floor time, 6-min walking distance, North Star Ambulatory Assessment [NSAA] score, and maximum circumference of both lower legs) of the patients in the outpatient clinic approximately 3 mo before, immediately before, and approximately 3 mo after the imposition of government-imposed travel restrictions.

Statistical comparisons for each motor function item were made between the amount of change in the period before the travel restrictions and that in the period after the travel restrictions. The latest measurement date before the travel restrictions was April 3, 2020. We regarded the conditions in the 3 mo preceding the travel restrictions as the natural clinical course. The ensuing condition of travel restrictions was considered as the period of reduced physical activity. Immediately following the travel restriction period, we also interviewed parents on how the patients had spent their time. The study and interviews were approved by the institutional ethical review board (no. 4790). Informed consent was obtained from all parents of study participants. All participants who were old enough to understand also assented to the study.

2.2 | Statistical analysis

BMI was compared immediately before and after the travel restriction period using paired *t*-tests. Regarding motor function, the amount of change in the 3 mo before the travel restrictions was compared with that in the 3 mo after the travel restrictions by paired *t*-tests. The Wilcoxon-signed rank test was used for nonparametric data. The significance level was set at $P < .05$. All statistical analyses were conducted using IBM SPSS version 26 software (IBM Corp., Armonk, NY, USA).

3 | RESULTS

3.1 | Physical characteristics

The patients ranged in age from three to 14 y (mean ± SD age: 9.8 ± 3.6 y) and included one preschooler, seven elementary school students, and four junior high school students. Eleven of 12 patients received steroid treatment, with one 3-y-old patient not administered steroids according to our therapeutic protocol for DMD.

The BMI of patients just before the travel restrictions was comparable to that after the travel restriction period approximately 3 mo later (22.4 ± 4.8 kg/m^2 vs. 22.7 ± 5.1 kg/m^2, 95% confidence interval −0.81120 to 0.24211; $P = .256$).

3.2 | Motor function

The Wilcoxon signed-rank test revealed significant bilateral decreases in the change in ankle joint dorsiflexion ROM after the travel restrictions as compared with the changes before the travel restrictions (Table 1, Figure 1A). In contrast, the changes in 10 m running time, rising from the floor time, 6-min walking distance, NSAA score, and maximum lower leg circumference were similar before and after the travel restrictions (Table 1, Figure 1).

TABLE 1 Changes in physical characteristics and motor function of study participants

	Period before the travel restrictions	Period after the travel restrictions	*P*-Value 95% CI
Right ankle dorsiflexion ROM (°) (n = 12)	1.3 ± 5.1	−4.6 ± 3.2	.020†
Left ankle dorsiflexion ROM (°) (n = 12)	−0.8 ± 4.9	−5.4 ± 4.8	.013†
10 m running time (s) (n = 8)	1.1 ± 2.4	−0.2 ± 0.4	.204†
Rising from the floor time (s) (n = 11)	1.4 ± 1.6	0.4 ± 0.8	.511* −.97971 to 1.79221
6-min walking distance (m) (n = 5)	−30.0 ± 58.1	−11.2 ± 77.3	.787* −199.39575 to 161.79575
NSAA score (n = 12)	−1.0 ± 1.9	−1.4 ± 1.9	.680†
Right maximum lower leg circumference (cm) (n = 12)	4.8 ± 9.6	0.8 ± 0.8	.720†
Left maximum lower leg circumference (cm) (n = 12)	4.7 ± 9.6	−1.5 ± 8.3	1.000†

Note: The varying number of patients analyzed for each item was due to the inability of some to perform the test because of severely reduced strength after the travel restrictions.

Abbreviation: CI, confidence interval.

*Paired *t*-test.

†Wilcoxon signed-rank test.

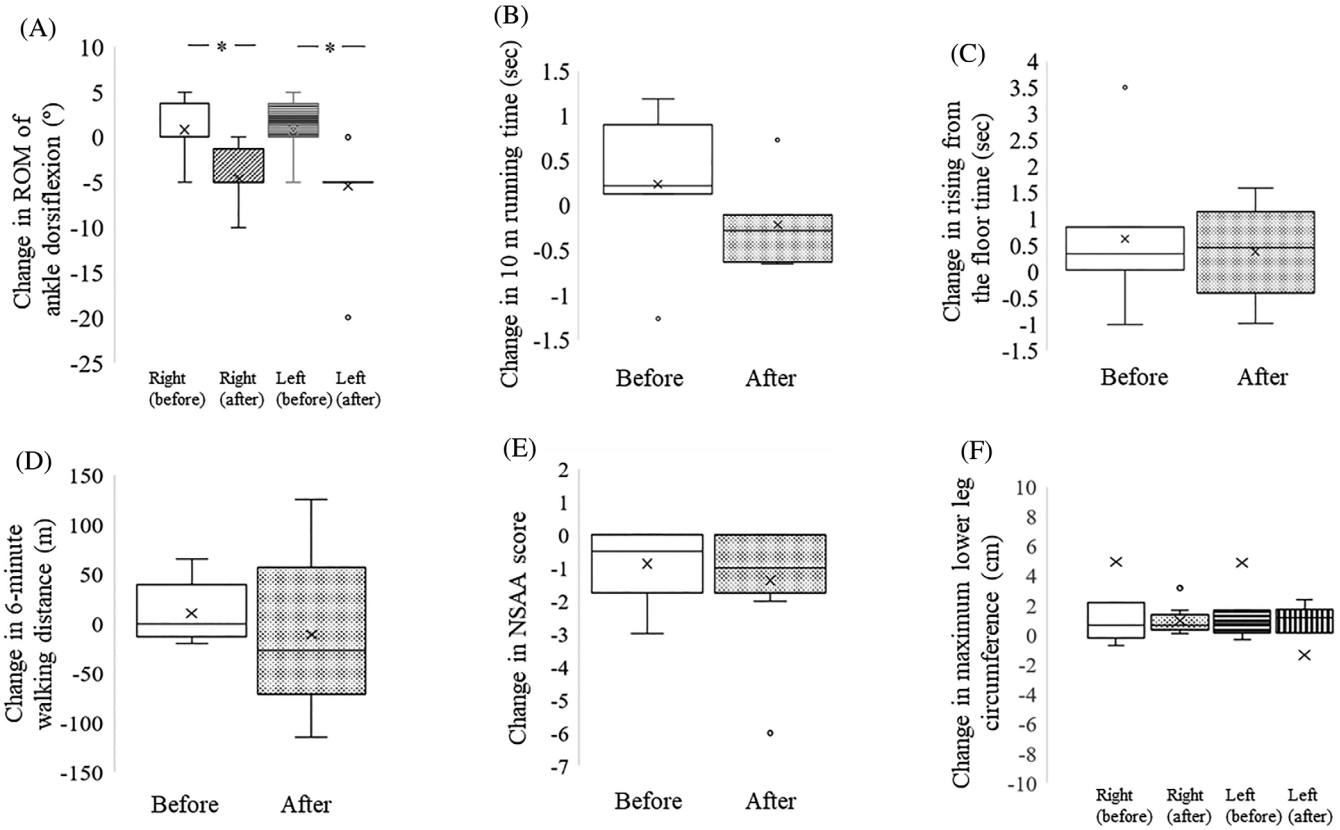

FIGURE 1 Comparison of motor function scores. Changes in motor function scores between the approximately 3-mo period before the travel restrictions and the approximately 3-mo period after the travel restrictions for ROM of ankle dorsiflexion (A), 10 m running time (B), rising from the floor time (C), 6-min walking distance (D), NSAA score (E), and maximum lower leg circumference (F). *$p < .05$

The results of interviews showed that more than half had decreased physical activity and movement in the travel restriction period as compared with beforehand. Seventy-eight percent of what the patients did after the travel restrictions was similar to what they did on usual holidays, including playing video games and watching videos and television. Sixty-seven percent of parents stretched their

child's body at least once a day. No patient received teletherapy after the travel restrictions because our hospital did not have an established teletherapy system.

4 | DISCUSSION

The present analysis revealed that the change in ankle dorsiflexion ROM was significantly decreased after the government-imposed travel restrictions as compared with the change beforehand. It appeared that the more sedentary lifestyle of the patients along with the lack of regular PT services contributed to this physical decline.

The change in ROM of ankle dorsiflexion was significantly decreased bilaterally after the travel restrictions, which implied that the changes in the natural course of DMD were worsened by movement restrictions. Joint ROM reportedly decreases by 0.4° per month without such intervention as PT.[8] In our study, the average monthly decrease in ankle dorsiflexion ROM after the travel restrictions was 1.5 and 1.8° on the right and left side, respectively. These were 3.8 and 4.5 times higher, respectively, than the values described by Seeger et al.,[8] demonstrating that the travel restrictions accelerated the progression of joint contractures and that at-home PT remained crucial.

We observed no remarkable changes in the other motor function tests. Although dorsiflexion ROM of the ankle joints has been shown to affect motor function after 1 y,[9] the travel restriction period in this study was only 3 mo. We therefore considered that minimum gross motor function could be maintained in this time frame.

With the closures of schools and outpatient treatment facilities due to the COVID-19 pandemic, many medical services were discontinued worldwide.[1] Patients with DMD may be at particularly high risk of experiencing serious complications from COVID-19 owing to their underlying immunosuppressed state from the use of corticosteroids and by secondary respiratory failure.[1] Thus, the government's travel restriction decree appeared necessary for DMD patients. However, we witnessed that a decrease in physical exercise in ambulatory DMD patients might initially cause or worsen joint contracture. Sarcomeres can be lost by up to 40% if muscles are shortened from a diminished ability to actively move limbs over their full ROM or from long-term static positioning.[7] Although 67% of parents stretched their child's ankle joints daily in this study, the significant decrease in dorsiflexion angle might have been related to a lack of exercise. Extended periods of travel restrictions may begin to adversely affect other motor functions as well.

Last, our results provide important clues on appropriate medical intervention when reduced physical activities become necessary. Throughout periods of restricted travel, regular PT services are still needed to actively check ROM and stretching methods as well as to propose home exercises to be done at least as frequently as in outpatient visits. Indeed, online rehabilitation strategies for various diseases have already been used effectively with the spread of COVID-19.[10-12]

The main limitation of this study was the lack of a true DMD control group who did no additional stretching in the travel restriction period.

5 | CONCLUSIONS

This study revealed that ankle dorsiflexion ROM in DMD patients after travel restrictions due to the global COVID-19 pandemic decreased significantly compared with the natural course of the disease, likely as a result of a more sedentary lifestyle and lack of regular PT services. Reduced exercise from travel restrictions may adversely affect joint ROM earlier than gross motor function. For similar circumstances during pandemics or disasters, it will be essential for physiotherapists to provide continued support by making effective use of remote rehabilitation strategies.

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CONFLICT OF INTEREST

None of the authors have any conflict of interest to disclose.

ETHICAL PUBLICATION STATEMENT

The authors confirm to have read the Journal's position on issues involved in ethical publication and affirm that this report is consistent with those guidelines.

DATA AVAILABILITY STATEMENT

Research data are not shared.

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Optimizing the operation of an electrodiagnostic laboratory during the COVID-19 pandemic: A 6-month single-center experience

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Abstract

Introduction/Aims: The initial surge of the coronavirus disease-2019 (COVID-19) pandemic in early 2020 led to widespread cancellation of elective medical procedures in the United States, including nonurgent outpatient and inpatient electrodiagnostic (EDx) studies. As certain regions later showed a downtrend in daily new cases, EDx laboratories have reopened under the guidance of the American Association of Neuromuscular & Electrodiagnostic Medicine (AANEM). In our reopening experience guided by the AANEM, we measured relevant outcomes to determine further workflow adaptations. We aimed to detail our experience and share the lessons learned.

Methods: We reviewed the clinical volumes, billing data, diagnosis distributions, and rates of COVID-19 exposure and transmission among patients and staff in our EDx laboratory during the first 6 months of reopening, starting on June 1, 2020. For context, we detailed the recent AANEM guidelines we adopted at our laboratory, supplemented by other consensus statements.

Results: We completed 816 outpatient studies from June 1 to December 1, 2020, reaching 97% of the total volume and 97% of total billing compared with the same time period in 2019. The average relative value units per study were similar. There were no major shifts in diagnosis distributions. We completed 10 of 12 requested

Abbreviations: AANEM, American Association of Neuromuscular & Electrodiagnostic Medicine; CPT, Current Procedural Terminology; COVID-19, coronavirus-2019; EDx, electrodiagnostic; NCS, nerve conduction studies; RVU, relative value unit.