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Original Article

Effectiveness of training patients using DVD in the accurate use of inhalers for the treatment of bronchial asthma

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ACT, Asthma Control Test; ICS, inhaled corticosteroids; FVC, forced vital capacity; FEV_1, forced expired volume in 1 s; IOS, impulse oscillometry; Fres, resonant frequency; FeNO, induced sputum eosinophil count and fractional exhaled nitric oxide

ABSTRACT

Background: Inhalants are the standard treatment for patients with bronchial asthma. Inaccurate inhaler use leads to inadequate therapeutic effects and unnecessary dosage increases. However, it is a challenge for practitioners to master the various devices available and train patients on the accurate use of inhalers. Thus, establishing a system to instruct patients on how to accurately use inhalers is essential. We prepared a DVD and accompanying user manual explaining the operation of each inhaler device used in Japan. This pilot study aimed to examine the efficacy of these materials.
Methods: The subjects were 33 outpatients with bronchial asthma who received treatment in our facility for asthma and had already received conventional inhalant training. The oral medication and inhalants used by the patients were not changed. The patients were randomly assigned to a DVD viewing group or non-viewing group; various parameters were comparatively examined after 4 weeks.
Results: Significant improvements in Asthma Control Test scores, inhalation technique, forced vital capacity, forced expiratory volume in 1 s, impulse oscillometry resonant frequency, and induced sputum eosinophil count were observed in the DVD viewing group at 4 weeks post training.
Conclusions: Pulmonary function and inflammatory parameters improved significantly in the DVD viewing group. These findings suggest that unnecessary step-up of asthma treatment can be avoided, leading to treatment cost reduction. Training patients with asthma in accurate inhaler use improves quality of life and therefore has great clinical significance. Hence, this method should be used more extensively in Japan and worldwide.
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Introduction

The primary symptom of asthma is chronic respiratory tract inflammation, which requires periodic inhalation therapy. In recent years, there has been an increase in the number of devices that have been developed, and because the methods of operation differ among inhalers, it is currently difficult for health care practitioners, as well as patients, to understand the correct method of use. If an inhaler is operated incorrectly, the drug's efficacy will be insufficient, which may lead to the condition being diagnosed as treatment-resistant and may lead to step-up of the treatment.[1] Ideally, inhalation training should be performed at all facilities nationwide and should consist of a common explanation to allow equal understanding among patients. Thus, in cooperation with the Environmental Restoration and Conservation Agency, the authors created a DVD entitled "Understanding the correct way to use inhalers" and an accompanying user manual to help patients understand how to operate all 12 types of inhalers currently sold in Japan (Environmental Restoration and Conservation Agency URL: http://www.erca.go.jp)[2] (Fig. 1). This is also listed in the Asthma Prevention and Management Guideline 2015, which provides verbal and written explanations.[3] Because the DVD is provided free of charge to patients, it can be watched at home and reviewed multiple times as required. The introduction of this tool makes it possible to provide consistent explanation on the technique of inhaler use; therefore, we performed a pilot study to test whether repeated use of the technique at home led to improved inhaler operation and improved therapeutic effects.

Methods

The subjects of the present study were 33 outpatients (13 men, 20 women) who were receiving treatment for asthma at our facility

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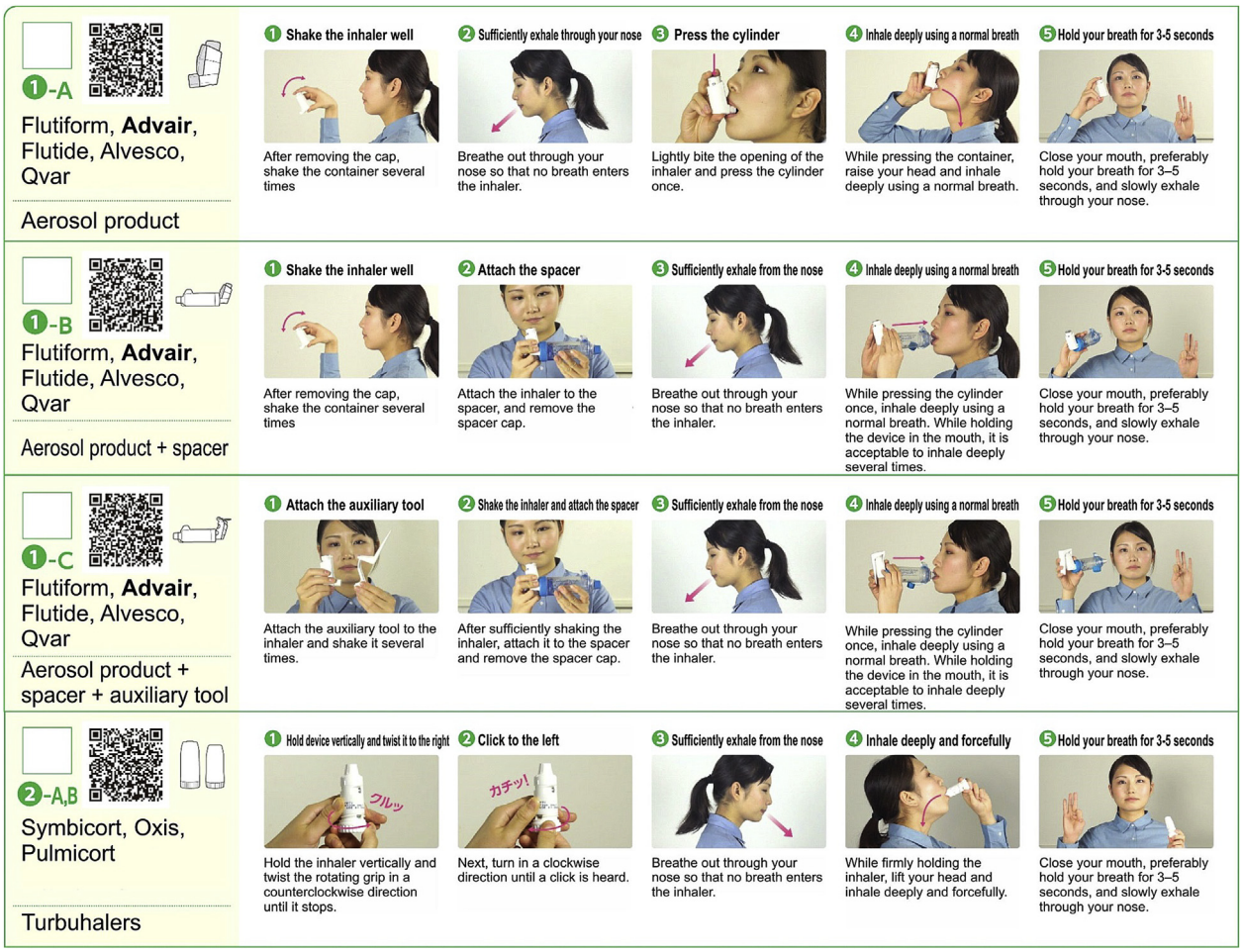

Fig. 1. Partial view of the user manual.

and had an Asthma Control Test (ACT) score of 20–24. For randomization, group names ("DVD viewing" and "DVD non-viewing") were written on paper and blindly drawn by the participants.

The mean age was 63.2 ± 15.7 years and age ranged from 38 to 88 years. Of the 33 patients, 21 were assigned to treatment step 3 and 12 were assigned to treatment step 4; a puffer metered-dose inhaler was used for 12 patients and a dry powder inhaler for 21 patients. The patients gave their consent in writing (Institutional Review Board of Fujita Health University School of Medicine, No. 15–334). The study design and items related to confirmation of the inhalation technique are shown in Figure 2. All subjects received treatment with inhaled corticosteroids (ICS); upon initiation of ICS treatment, the patients received training in the technique of using an inhaler from a pharmacist, using the conventional package insert with the help of a practice inhaler. No changes were made to their current oral medications or inhalants, and the subjects were randomly assigned to the DVD viewing group (17 subjects) or DVD non-viewing group (16 subjects). The subjects in the DVD viewing group viewed the DVD, received more training in the technique of inhaler use from a physician, and were instructed to view the DVD at home. The subjects in the DVD non-viewing group received conventional training in inhalation technique. We measured various parameters (ACT, mastery of inhalation technique, forced vital capacity [FVC], forced expired volume in 1 s [FEV_1], impulse oscillometry [IOS], resonant frequency [Fres], induced sputum eosinophil count and fractional exhaled nitric oxide [FeNO]) in both groups at 4 weeks following training. A CHESTAC8800 device (Chest M.I. Inc., Tokyo, Japan) was used to perform spirometric measurements, and Master Screen-IOS (Jaeger GmbH, Höchberg, Germany) was used to measure Fres at 30-s intervals during breathing, at rest. The induced sputum eosinophil count was determined by making subjects continuously inhale a 5% hypertonic saline solution during a 20-min period, collecting sputum, and analyzing the cell fractionation. NiOX (Aerocrine, Stockholm, Sweden) was used to measure the FeNO. We compared the inter-group differences for each parameter before training and at 4 weeks following training, and performed *t*-tests for all statistical analyses. Values of $p < 0.05$ were considered statistically significant. A part of the user manual is shown in Figure 1.

All statistical analyses were performed using StatView J-5.0 software (SAS Institute Inc., Cary, NC, USA).

Results

The background characteristics and parameters tested for the DVD viewing and DVD non-viewing groups are shown in Table 1. No significant inter-group differences were observed.

A comparison of ACT in the DVD viewing group ($p = 0.002$) and DVD non-viewing group ($p = 0.1679$) revealed a significant improvement in the former (Fig. 3). A comparison of the inhalation technique in the DVD viewing ($p < 0.0001$) and DVD non-viewing groups ($p = 0.0002$) revealed a significant improvement in the former (Fig. 3).

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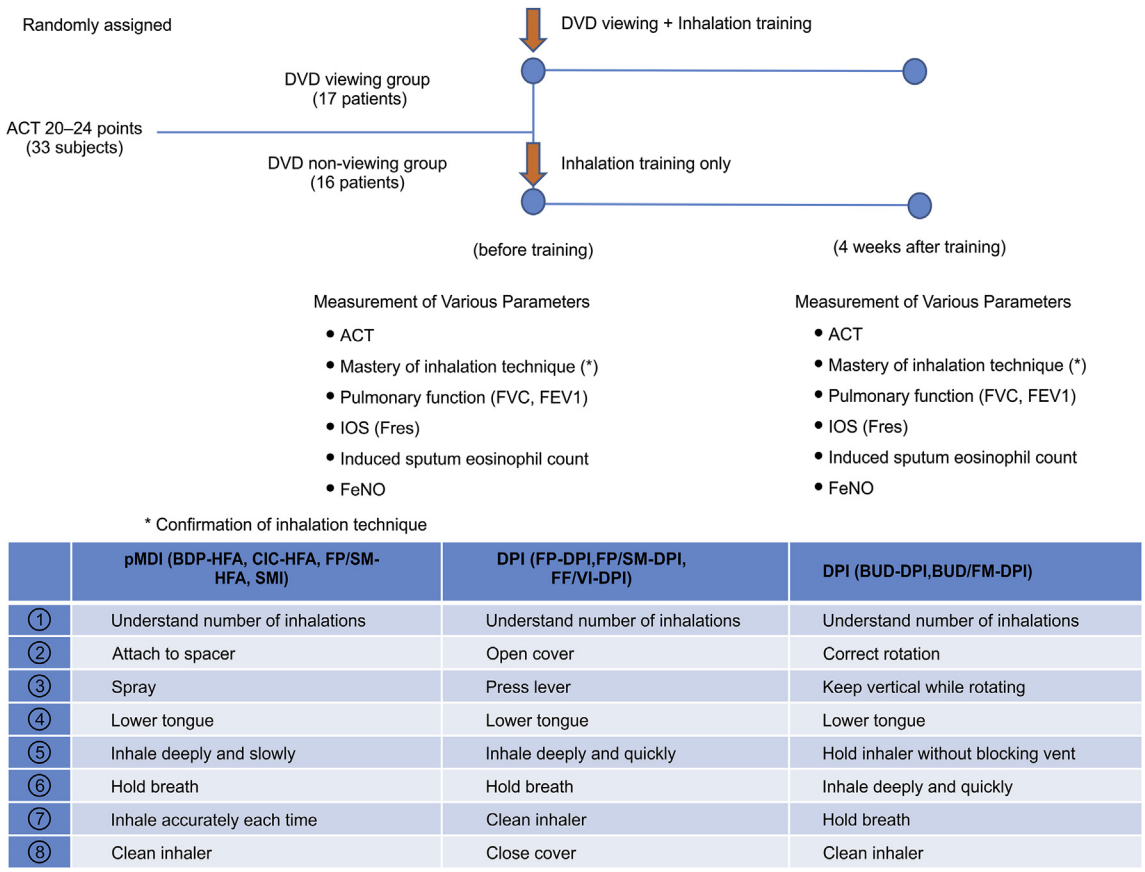

	pMDI (BDP-HFA, CIC-HFA, FP/SM-HFA, SMI)	DPI (FP-DPI,FP/SM-DPI, FF/VI-DPI)	DPI (BUD-DPI,BUD/FM-DPI)
①	Understand number of inhalations	Understand number of inhalations	Understand number of inhalations
②	Attach to spacer	Open cover	Correct rotation
③	Spray	Press lever	Keep vertical while rotating
④	Lower tongue	Lower tongue	Lower tongue
⑤	Inhale deeply and slowly	Inhale deeply and quickly	Hold inhaler without blocking vent
⑥	Hold breath	Hold breath	Inhale deeply and quickly
⑦	Inhale accurately each time	Clean inhaler	Hold breath
⑧	Clean inhaler	Close cover	Clean inhaler

Fig. 2. Study design.

A comparison of FVC in the DVD viewing group ($p = 0.0008$) and DVD non-viewing group ($p = 0.1436$) revealed a significant improvement in the former (Fig. 4). Similarly, a comparison of FEV_1 in the DVD viewing group ($p = 0.0214$) and DVD non-viewing group ($p = 0.0484$) revealed a more significant improvement in the former (Fig. 4). Furthermore, a comparison of IOS (Fres) in the DVD viewing group ($p = 0.0018$) and DVD non-viewing group ($p = 0.0733$) revealed a significant improvement in the former (Fig. 4).

Table 1
Characteristics of the study participants.

Characteristics	DVD viewing group (n = 17)	DVD non-viewing group (n = 16)	
Age (years)	62.9 ± 15.4	63.6 ± 16.1	n.s.
Gender (male/female)	7/10	6/10	
Smoking history (never smoker/ex-smoker)	6/11	6/10	
Device (pMDI/DPI)	5/12	7/9	
ACT	21.83 ± 1.42	22.10 ± 1.63	n.s.
Confirmation of inhalation technique	4.35 ± 0.70	4.31 ± 0.60	n.s.
FVC (L)	2.92 ± 0.83	2.87 ± 1.02	n.s.
FEV_1 (L)	2.11 ± 0.57	2.00 ± 0.68	n.s.
IOS (Fres, 1/s)	16.22 ± 6.02	17.03 ± 6.15	n.s.
Induced sputum eosinophil count (%)	5.52 ± 1.51	5.50 ± 1.69	n.s.
FeNO (ppb)	45.19 ± 45.34	41.50 ± 46.24	n.s.

Data are the number or the mean ± standard deviation.
pMID, puffer metered-dose inhaler; DPI, dry powder inhaler; ACT, Asthma Control Test; FVC, forced vital capacity; FEV_1, forced expired volume in 1 s; IOS, impulse oscillometry; Fres, resonant frequency; FeNO, induced sputum eosinophil count and fractional exhaled nitric oxide.

A comparison of induced sputum eosinophil count in the DVD viewing group ($p = 0.0006$) and DVD non-viewing group ($p = 0.2149$) revealed a significant improvement in the former (Fig. 5). However, a comparison of FeNO in the DVD viewing group ($p = 0.0927$) and DVD non-viewing group ($p = 0.01296$) revealed no significant inter-group differences (Fig. 5).

Discussion

The 2015 Asthma Prevention and Management Guidelines[3] recently noted the importance of using accurate methods of inhalation. Use of incorrect inhalation techniques has occurred at an unacceptable rate over the past 40 years (1975–2014). Because this situation has not been corrected,[4] it has been reported that the inhalation technique should be reconsidered in patients with poor asthma control, even in cases where a device that is less prone to erroneous operation is used.[5] In the case of training provided by family physicians (physicians in private practice), it has also been reported that training in correct inhalation technique improves patients' attitudes and facilitates clinical practice.[6] Therefore, the introduction of a consistent training program for accurate inhaler use in medical institutions is an urgent issue.

Towards this end, in cooperation with the Environmental Restoration and Conservation Agency in Japan, the authors created a DVD entitled "Understanding the correct way to use inhalers" and an accompanying user manual to help patients understand the method of operation for all the 12 inhaler types currently sold in Japan, and then examined the utility of this method. Our results revealed significant improvements in ACT, mastery of the inhalation technique, FVC, FEV_1, IOS (Fres) levels, and induced sputum

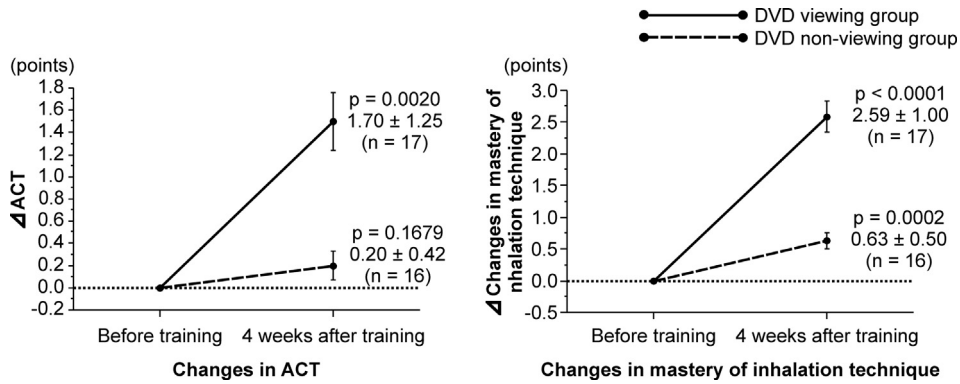

Fig. 3. Changes in parameters at 4 weeks after inhalation training using DVD.

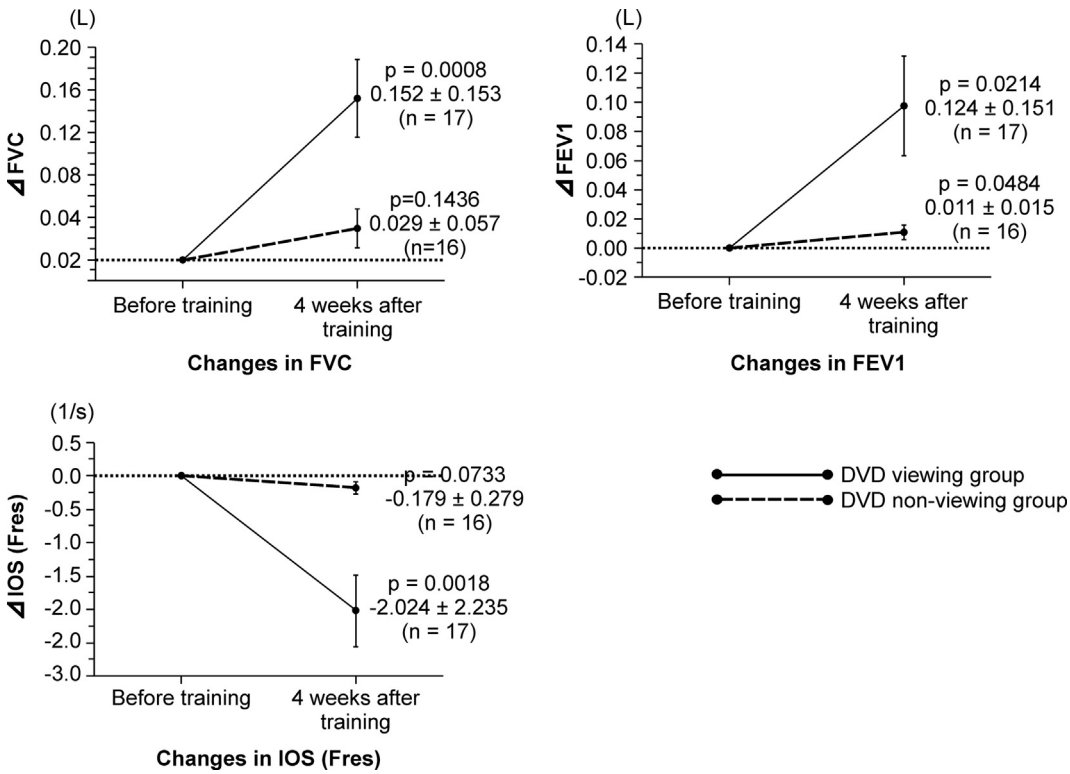

Fig. 4. Changes in respiratory function parameters at 4 weeks after inhalation training using DVD.

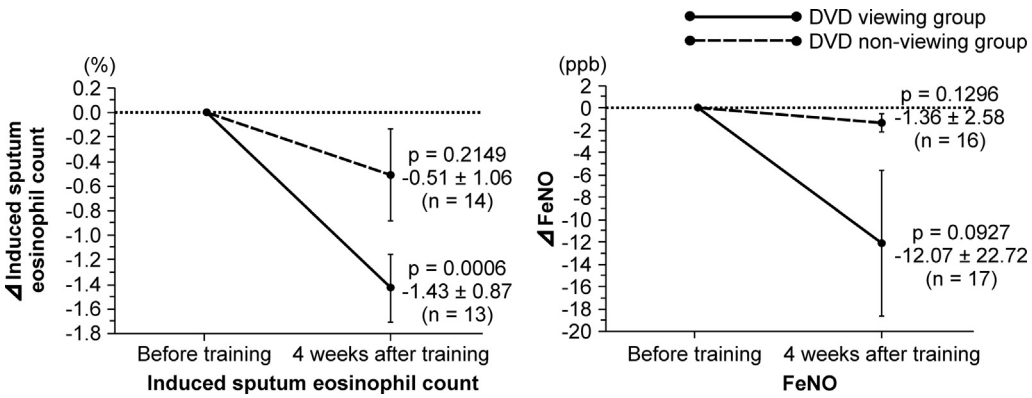

Fig. 5. Changes in respiratory function parameters at 4 weeks after inhalation training using DVD.

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eosinophil count in the DVD-viewing group at 4 weeks following training. No significant differences were noted in FeNO, but a trend towards improvement was observed in the DVD-viewing group. It is the authors' opinion that accurate inhaler operation was due to patients viewing the DVD, which allowed an appropriate amount of the drug to reach the trachea and made it possible to obtain an anti-inflammatory effect. The advantages of viewing the DVD are as follows:

1) Movements that cannot be sufficiently expressed through the package insert can be easily understood via DVD.
2) Patients who are unable to read the package insert due to small font size can listen to the narration on the DVD.
3) Because it is possible to take the DVD home, the patients are more relaxed.
4) If the patient is unable to understand the contents after a single viewing, he or she can repeatedly watch it at home.
5) Because it is possible to watch the DVD with family members, it is easy for patients to obtain their cooperation.
6) It is possible that accurate inhalation maximizes the drug's efficacy, which may reduce costs.

There are several limitations to this pilot study. The number of patients is relatively small, and only one institution was involved. With the proof of concept demonstrated, this study should be expanded and broadened to show generalizability of our results.

The length of the study was relatively short. Assessments were made after 4 weeks. Follow-up studies should examine the effects of the intervention after 6–12 months. Elderly patients (70 years and older) should be studied for at least an additional 3 months.

Each type of inhalation device presents its own set of technical difficulties. The small sample size here does not allow comparison among the several devices. Further, large-scale studies should elucidate these differences, if any.

We did not ask study participants how many times they watched the DVD. Repetition of instruction is important for learning correct technique. Further studies should address this question and correlate the number of viewings with outcomes.

Our results suggest that during training of patients in the technique of using the inhaler, addition of the package insert and a DVD to give a more detailed explanation makes it possible to achieve consistent training for patients throughout all facilities. Moreover, our study indicates that correct use of the inhaler may be directly linked with improved efficacy of treatment, which could prevent unnecessary step-up of treatment. Thus, it is the authors' opinion that the clinical significance of this tool is substantial.[7,8] If this type of training can be popularized in Japan as well as throughout the world, an increase in asthma treatment efficacy can be anticipated.

Conflict of interest

The authors have no conflict of interest to declare.

Authors' contributions

KT, RK, and TH conceptualized and designed the study, collected data, analyzed and interpreted data, drafted the manuscript and critical revised the manuscript. All authors read and approved the final manuscript.

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