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The effect of walking aids on exercise capacity and oxygenation in elderly patients with chronic obstructive pulmonary disease

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Abstract

Background: high walking frames may improve exercise capacity in young patients with chronic obstructive pulmonary disease (COPD). We have assessed the effect of Zimmer, rollator and gutter frames on 6-min walking distance and on arterial oxygenation during exercise in elderly patients with COPD.
Methods: 27 out-patients (15 men) aged 70–82 (mean 75) years were recruited. Exclusions comprised: COPD exacerbation or oral steroid use within 6 weeks, confusional state, participation in a pulmonary rehabilitation programme and exercise limitation by other diseases. Subjects completed 6-min walk tests unaided and with the three frames on four separate days in random order 30 min after nebulized salbutamol (5 mg) and ipratropium (0.5 mg) and were accompanied by an investigator blinded to results of all other walk tests undertaken. Oxygen saturation (SaO_2) was monitored by finger probe during exercise. Grouped *t*-tests were used to compare distances and reductions in SaO_2.
Results: Unaided, the mean (SEM) 6-min walk distance was 210 (16) m and fall in oxygen saturation was 6.0 (1.1)%. Use of a rollator frame did not significantly affect either of these values. Using the Zimmer frame reduced the mean distance to 165 (13) m ($t = 5.2$, $P < 0.001$ *vs* unaided walk) with an SaO_2 fall similar to that recorded during the unaided walk. Using the gutter frame increased the mean distance to 234 (150) m ($t = 3.1$, $P = 0.004$ *vs* unaided walk) and reduced the fall in SaO_2 to 3.7 (0.8)% ($t = 2.3$, $P = 0.03$ *vs* unaided walk).
Conclusions: gutter frames improve exercise capacity and SaO_2 during exercise in elderly COPD patients who remain symptomatic on optimal therapy, whereas unwheeled Zimmer frames have a deleterious effect in such patients.

Keywords: *chronic obstructive pulmonary disease, exercise capacity, gutter frame, oxygen saturation, walking aids*

Introduction

Chronic obstructive pulmonary disease (COPD) is a major cause of morbidity and disability in elderly people [1]. The main disabling symptoms are breathlessness and fatigue, both of which lead to reduced exercise capacity and difficulties in performing activities of daily living.

Walking aids improve walking distance [2, 3] and breathlessness [4] in relatively young patients with COPD. These studies [2–4] included only a small number of patients and did not evaluate the effect of different frames (wheeled or non-wheeled) on walk distance in a blinded manner.

We hypothesized that if walking frames were beneficial to patients with a respiratory disability, much of the benefit would arise from the ability of the patient to lean on the frame during walking, thus bracing the accessory muscles of respiration and allowing them to be engaged in respiratory activities. Such an action would be facilitated by wheeled walking frames which should therefore have an advantage over non-wheeled frames. Indeed, we thought it possible that non-wheeled frames would have a disadvantage because of the necessary extra muscular activity involved in repeatedly lifting such frames. The aim of the present study was to assess the effect of an unwheeled walking aid (Zimmer frame) and wheeled

frames (rollator frame and gutter frame) on the 6-min walking distance and on oxygen saturation during exercise.

Methods

Elderly COPD patients were referred to the pulmonary rehabilitation clinic at the geriatric day hospital because of dyspnoea, fatigue, reduced exercise tolerance and difficulty performing activities of daily living despite optimum medical therapy. The diagnosis of COPD was made by history, physical examination and pulmonary function testing. Spirometric criteria for inclusion were forced expiratory volume in 1 s (FEV_1) of <60% of predicted, FEV_1/forced vital capacity (FVC) ratio of <60%, and a rise in FEV_1 of <15% following nebulized salbutamol (5 mg) and ipratropium (0.5 mg). Patients with COPD who were aged 70 or older were recruited to the study if they were clinically stable with no change in medication in the previous month and no hospital admission for respiratory illness in the previous 6 weeks. Exclusion criteria comprised: acute or chronic confusion (Hodkinson Abbreviated Mental Test Score ≤7/10 [5]), previous experience of the walk test or current involvement in a pulmonary rehabilitation programme, uncontrolled cardiac arrhythmia, severe cardiac failure or uncontrolled ischaemic heart disease or exercise limitation by factors other than dyspnoea and fatigue (such as visual impairment, musculoskeletal problems, neurological impairment and peripheral vascular disease). However, subjects with other disabilities were included if the subjects themselves considered their respiratory problems to be the chief cause of their exercise limitation.

The study was approved by ethical committees of Central Manchester Healthcare Trust and Bury Health Authority, and informed, witnessed, written consent was obtained from all subjects.

Spirometry was performed using a Compact C spirometer (Vitalograph Ltd, Buckingham, UK), which was calibrated daily. Patients performed FVC tests seated and wearing a nose clip. Three reproducible readings (±5% FEV_1) were taken at 1 min intervals and the best result recorded. Predicted values were obtained from the equations given by Cotes [6]. Exercise capacity was assessed by a 6-min walk test [7].

Patients attended the geriatric day hospital on four separate days. Spirometry and reversibility was measured on the first visit. Each subject performed one 6-min walk test at each visit, either unaided or with a Zimmer frame, rollator (wheeled frame) or gutter (high, wheeled) frame in random order. All walk tests were performed at the same time of day, under identical conditions, 30 min after the inhalation of nebulized salbutamol (5 mg) and ipratropium (0.5 mg), and at least 2 h after the last meal. Repeat walk tests were monitored by different blinded investigators. Investigators acted as time-keepers, following (not leading) the patient and carrying the pulse oximeter (see below). Each walk test was begun at a different point along the course to minimize the ability of the patient to compare his or her performance with that in previous tests. Patients were allowed to rest during the 6 min, but advised that the aim was to walk as far as possible in the allotted time and that timing would continue when they were resting.

Exercise-related arterial oxygen desaturation was assessed during the walk test by a portable pulse oximeter (Pulsox-7, Minolta, DeVilbiss, Heston, UK) using a finger probe. Baseline oxygen saturation immediately before the start of the walk test and the minimum saturation during the test were noted. Exercise-related desaturation (%) was defined as baseline saturation minus minimum saturation.

Statistical analysis

Paired *t*-tests were used to compare differences in 6-min walk distance and oxygen saturation. Significance was defined at the 5% level.

Results

All data are presented as mean values (standard error).

Twenty-seven patients (15 men) with a mean age of 75.1 (range 70-82) years were recruited. Mean pack-years smoked (1 pack-year = 20 cigarettes per day for 1 year) was 28.8 (5.6) and mean FEV_1 was 1.01 (0.07) l, representing 49.5 (4.2)% of the predicted value. Mean FEV_1/FVC ratio was 44.2 (2.0)%.

Table 1 presents the walk distance and fall in oxygen saturation for each walk test. Subjects using a rollator frame showed a walk distance and oxygen desaturation very similar to that seen when walking unaided. When a Zimmer frame was used, walk distance was shorter but there was no significant change in oxygen desaturation. In contrast, using a gutter frame resulted in greater walk distance and significantly less oxygen desaturation.

Discussion

The results of this study support our initial hypothesis that a high, wheeled walking frame improves exercise capacity in elderly patients with COPD whereas a Zimmer (unwheeled) frame reduces it. In addition to improving walk distance, use of the high, wheeled walk frame (gutter frame) was associated with reduced oxygen desaturation during exercise. These results are consistent with those of Grant and Capel [3] who found a high, wheeled walker doubled walk distance in five younger subjects with COPD (age 55-65 years). However in that study the walking speed was reduced and the improvement in distance walked was achieved by an increase in endurance, since patients were

Table 1. Six-minute walk distances and oxygen saturation measurements

	Mean value (SEM)		
		Oxygen saturation (%)	
	Walk distance (m)	At rest	Fall during exercise
Unaided	210 (16)	93.0 (0.7)	6.0 (1.1)
With Zimmer frame	165 (13)[a]	93.0 (0.8)	6.0 (0.7)
With rollator frame	212 (17)	92.3 (17)	5.4 (0.9)
With gutter frame	234 (15)[b]	93.0 (0.5)	3.7 (0.8)[c]

Statistical comparisons by paired *t*-test *versus* unaided walk. [a] $t = 5.2$, $P < 0.001$; [b] $t = 3.1$, $P = 0.004$; [c] $t = 2.3$, $P = 0.03$; all others non-significant.

allowed to walk as far as they could, however long this took. Furthermore, despite being younger, these patients had more severe airways obstruction. Dalton *et al.* [4] showed that a wheeled walker did not improve 6-min walk distance, although it did reduce breathlessness during the walk test—again in younger COPD patients (mean age 65 years). We did not assess breathlessness in our study although many patients spontaneously reported that they felt less breathless with the gutter frame.

It is likely that the negative effect on walk distance when using the Zimmer frame was at least in part the result of the extra metabolic requirements of repeatedly lifting and moving the frame. Work involving arm elevation is more demanding with respect to metabolic and ventilatory response for patients with COPD than for age-matched healthy subjects [8, 9]. Alternatively, the stop-start action of the Zimmer frame may have contributed to a slower walk by mechanisms unrelated to respiratory problems.

Celli and colleagues [9, 10] noted that during unsupported arm work, the accessory muscles of respiration help position the torso and arms and therefore decrease their participation in respiration. Optimum function of the accessory muscles is facilitated by bracing of the arms, as achieved when using a wheeled frame. A more erect posture (vertebral extension) facilitates greater elevation of the ribs during inspiration and may allow the anterior abdominal muscles to become more effective in respiration. This may partly explain why the gutter frame, which tends to facilitate an erect posture, is of benefit in this situation [3].

It is unclear why gutter frame use was associated with reduced oxygen desaturation during exercise. Perhaps the oxygen cost of exercise was reduced, and indeed this mechanism was suggested in an early case report on the use of a high, wheeled walking frame [2]. However we did not measure the oxygen uptake during the walk tests and this might be worthy of further study. Similarly, further investigation of the sensation of dyspnoea using different frames would be a worthy endeavour.

It is unlikely that a learning effect was implicated in our findings, as (i) we randomized the order of frame usage, thereby minimizing or eliminating any effect of learning to use a frame, and (ii) we have previously shown the absence of a learning effect in unaided 6-min walk tests in elderly patients disabled by COPD [7].

This study has not focused on patient acceptability of gutter frames. The mean improvement in walk distance with the gutter frame was relatively small (approximately 10%). These frames are rather large, potentially unwieldy and perhaps an unacceptable sign of disability. Some patients may find the benefit they convey outweighed by their disadvantages. Indeed, frames are often discarded by elderly patients with other medical conditions after discharge from hospital [11]. Our patients had only moderate impairment of lung function. Those more severely impaired might derive greater benefit from use of the gutter frame, perhaps with a portable oxygen cylinder attached to the frame [2]. These possibilities are worth further study.

The speed of walking may not be the most important requirement of a patient with respiratory disability and total exercise tolerance (i.e. maximum distance attainable irrespective of time taken) may be more important. This merits investigation.

We conclude that, in those elderly patients with COPD who remain disabled despite optimum medical therapy and following a pulmonary rehabilitation programme, a trial of a gutter frame is worthwhile. Zimmer frames should be avoided if possible for these patients, even when a frame is needed for other reasons. If a patient finds the gutter frame unacceptable, a rollator frame should be the next choice.

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Key points

- Reduced exercise capacity is common in elderly patients with chronic obstructive pulmonary disease, even when receiving maximal medical treatment.
- In patients with chronic obstructive pulmonary disease the use of a gutter (high, wheeled) walking frame increases walk speed and reduces oxygen desaturation during exercise.
- Low, unwheeled Zimmer frames are best avoided as they result in reduced walking speed in these patients.

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