

# “Graded Cycling Test with Talk Test” Is a Reliable Test to Monitor Cardiovascular Fitness in Patients with Minor Stroke

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*Background:* Physical exercise is generally recommended as part of life style changes post stroke. Monitoring cardiovascular effects may help motivate patients for further exercise, and can be an instrument to assess intervention effects in clinical trials. In 1 of 4 stroke patients, the heart rate variability may challenge currently used cardiovascular monitoring. The Graded Cycling Test with Talk Test is a submaximal exercise test independent of heart rate variability, shown reliable for patients with cardiac disease. *Methods:* Patients diagnosed with lacunar stroke according to TOAST (Trial of Org 10172 in Acute Stroke Treatment) criteria performed an incremental exercise test on a stationary bicycle with a 15 W (watt) increase in workload every minute. Toward the end of each incremental step, the patients recited a standardized text passage and subsequently were asked: “Are you still able to speak comfortably?” The test was stopped when the patients were no longer able to speak comfortably. Two consecutive tests were performed separated by 1 hour rest. *Results:* Sixty patients completed the study. The intraclass correlation coefficient (ICC<sub>2,1</sub>) was as follows: .97 [95% CI: .95-.98] with only a minor measurement error: 12.9 W for groups of patients (standard error of measurement, SEM<sub>95</sub>) and 18.3 W for individual patients (smallest real difference). *Conclusion:* The “Graded Cycling Test with Talk Test” is feasible and reliable for monitoring exercise effects in patients with lacunar stroke. The high ICC<sub>2,1</sub> and small measurement error suggest it to be a valuable outcome measurement in clinical practice. **Key Words:** Graded Cycling Test—lacunar stroke—outcome assessment—reproducibility of results—Talk Test.

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## Introduction

Physical exercise is generally recommended as one of the life style changes for poststroke patients to reduce risk of cardiovascular events or recurrent strokes.<sup>1</sup> Patients with a lacunar stroke, caused by small vessel disease (SVD), have a threefold greater risk of subsequent new stroke.<sup>2,3</sup> Evidence supports that physical activity after a stroke can lower the blood pressure and improve cardiovascular fitness.<sup>4</sup> A test of aerobic capacity is necessary to assess the short-term effects of exercise intervention on stroke patients. In 20%-30% of patients with stroke, the heart rate variability may be affected by atrial fibrillation,<sup>5,6</sup> and likewise in patients treated with heart rate regulating medication, such as beta blockers. This may challenge the outcome of exercise testing which is

based on measurement of heart rate. Furthermore, the direct measurement of maximal aerobic capacity is strenuous for the patient and requires advanced equipment and expertise, and submaximal exercise tests such as Åstrand Test<sup>7</sup> are often based on heart rate measurements. Consequently, a simple, standardized, submaximal exercise test which is independent of the heart rate would be more suitable for use in the clinic. The Graded Cycling Test with Talk Test is a submaximal exercise test feasible and reliable for use in patients with cardiac disease.<sup>8</sup> We thus hypothesize that the Graded Cycling Test with Talk Test is also feasible and reliable for patients with a lacunar stroke. It is essential to establish whether this is the case as stroke patients may perform differently from cardiac patients as stroke patients are older and may suffer from stroke sequelae. So far there are no studies validating the Graded Cycling Test with Talk Test against direct measurement of maximal oxygen consumption or the ventilatory threshold in any patient group. The Talk Test by itself has, however, been used with a variety of incremental exercise test protocols—i.e., during treadmill walking,<sup>9-11</sup> corridor walking,<sup>10</sup> and stationary bicycling.<sup>12-14</sup> Regardless of exercise mode and protocol, the last positive, or in most cases the equivocal, stage in the Talk Test has been found to correlate with the ventilatory threshold in elite and recreational athletes,<sup>12,15</sup> sedentary and healthy adults,<sup>9,15,16</sup> as well as in cardiac patients.<sup>10,11,13,17</sup> Further, the Talk Test is responsive to changes in aerobic capacity following blood donation and aerobic training.<sup>9</sup> The current study investigates feasibility and reproducibility in patients with a lacunar stroke, as this is the group of patients who are most likely to engage in physical exercise immediately post stroke.

## Methods

The study was approved by The Danish Data Protection Agency (ID: 2012-58-0004) and The Research Ethics Committee in the Capital Region of Denmark (H-1-2014-FSP-031) according to the Declaration of Helsinki of 1964, as revised in 2008. All participants gave written informed consent before enrollment.

### *Participants*

The study was designed as a test-retest study, including patients with lacunar stroke from Herlev Gentofte Hospital from October 1, 2014 to May 1, 2015. We aimed to include at least 60 patients, in accordance with the COSMIN checklist (COnsensus-based Standards for the selection of health Measurement INstruments) for reliability studies.<sup>18</sup> The patients included in the study were patients with a first time lacunar stroke (24 patients), patients with a recurrent lacunar stroke (21 patients) verified by acute computed tomography (CT) or magnetic resonance imaging (MRI) scans, or patients suffering from symptoms of lacunar stroke with evidence of only old

lacunar infarcts but no new lesion verified by CT or MRI scans (15 patients). Both inpatients and outpatients were included in the study to ascertain if the Graded Cycling Test with Talk Test was applicable during the entire rehabilitation period. Inpatients were recruited consecutively from the stroke unit. Outpatients were recruited either shortly after discharge ( $n = 12$ ) or from patients attending their 3 months control visit ( $n = 8$ ), or their later follow-up visit at the stroke unit (1 patient at 6 months and 2 patients at 12 months).

### *Selection Criteria*

The lacunar infarct was verified by clinical examination and CT or MRI scans, and defined as small infarcts (<2 cm diameter, in the acute stage) according to the TOAST (Trial of Org 10172 in Acute Stroke Treatment) criteria for SVD stroke.<sup>19</sup>

Inclusion criteria were as follows: age more than 18 years; ability to speak and read Danish; and ability to give informed consent. Exclusion criteria were as follows: previous large artery stroke; symptoms or comorbidities in the musculoskeletal system, which could hinder exercise testing on a stationary bike; dyspnoea caused by heart or pulmonary disease; and aphasia or dementia which could hinder completion of the Talk Test.

### *Test Protocol*

The test leader (R.S.K.) was formally instructed in the test procedure by an experienced tester who had conducted more than 200 tests. A pilot study was done prior to the main study, including 5 healthy subjects and 5 patients with lacunar stroke. The purpose of the pilot study was to practice the test procedure including observations and instructions. All patients performed a test trial prior to the day of reliability testing to get familiarized with the testing procedure and thus minimize the risk of bias due to learning effect. For the reliability study, the cycling test was performed under identical conditions twice on the same day. The 2 test trials were separated by 1 hour of rest, during which only water was offered to the patients. The test was performed in an undisturbed examination room with daylight illumination and an average temperature of 20°C on a stationary bike (Monark 928E-G3, Vansbro, Sweden). The bike was electronically braked and calibrated daily before testing. The patients wore a heart rate monitor (Polar FS2c, Kempele, Finland) around the chest. During the test, the current heart rate was displayed on a computer, not viewable for the patients. The heart rate was monitored (in beats per minute, bpm) to ensure that the increasing workload during the cycling test resulted in an appropriate increase in exercise intensity.

The patients cycled for a period of 2 minutes at a low intensity (15 W [watt]), at 60 rounds per minute (rpm). The intensity was then increased automatically by 15 W

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