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## Différentes modalités d'évaluation de la distance de marche chez l'artériopathe claudicant : sensibilité au changement après rééducation

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**DIFFERENTES MODALITES D'EVALUATION DE LA  
DISTANCE DE MARCHE CHEZ  
L'ARTERIOPATHE CLAUDICANT : SENSIBILITE AU  
CHANGEMENT APRES REEDUCATION**

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**THESE PRESENTEE POUR L'OBTENTION DU DOCTORAT EN MEDECINE  
DIPLOME D'ETAT**

Elodie GAILLED RAT  
Née le 26 Avril 1983 à CHEVREUSE

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DEVANT LE JURY COMPOSE DE :

Président du jury : Monsieur le Professeur Dominic PERENNOU

Membres : Monsieur le Professeur Jean Luc MAGNE

Monsieur le Professeur Patrick CARPENTIER

Monsieur le Professeur Jean Louis PEPIN

Monsieur le Docteur Michel GUINOT

Madame le Docteur Béatrice VILLEMUR



*Vita brevis, ars longa, occasio praeceps,  
experientia fallax, iudicium difficile.*

*La vie est courte, l'art est long, l'occasion fugitive,  
l'expérience trompeuse, le jugement difficile.*

*Hippocrate*

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## Abstract

### RESPONSIVENESS OF WALKING DISTANCE ASSESSMENTS AFTER REHABILITATION IN PERIPHERAL ARTERIAL DISEASE

**Key Words:** evaluation, claudication, peripheral arterial disease, rehabilitation, walking test

**Objective:** Peripheral arterial disease with claudication affects 0.8 to 1.5 % of the population, and the first intention treatment is actually the rehabilitation. There is no consensus as for the way of estimating this rehabilitation. This study has for objective to test the sensitivity to change of several methods of walking evaluation, as well as other parameters.

**Methods:** This study concerns the first 19 patients included in the study ARTEX (clinical trial of walking rehabilitation for peripheral arterial disease). Before and after 4 weeks of rehabilitation, patients benefited from following evaluations: walking distances were analyzed by the six minute walk test, the Strandness test (speed and slope constant) and a graded treadmill test (with slope increase), as well as cardiovascular parameters (transcutaneous oxygen pressure, ankle-to-brachial systolic blood press index, maximal cardiac frequency and peak oxygen consumption), and psychological measures (Hospital Anxiety and Depression Scale).

**Results:** Tests with significant change after rehabilitation were: six minute walk test ( $345.2 \pm 77.2$  meters vs  $385 \pm 62.6$ ,  $p < 0.05$ ), Strandness test ( $310.5 \pm 375.8$  vs  $620 \pm 755$ ,  $p=0.001$ ), graded treadmill test ( $741.6 \pm 818.6$  vs  $1397.9 \pm 1054.6$ ,  $p < 0.001$ ), and anxiety and depression scores of the Hospital Anxiety and Depression Scale ( $6.5 \pm 3.9$  vs  $5.4 \pm 4.0$ ,  $p < 0.05$  for the anxiety score, and  $5.3 \pm 3.3$  vs  $4.4 \pm 2.9$ ,  $p < 0.05$  for the depression score). Among the three walking tests, the graded treadmill test had significant better gains (171.4 %, vs 105.5 % for the Strandness test, and 11.53 % for the six minute walk test) ( $p=0,001$ ).

**Conclusion:** This study confirms the important profit of the rehabilitation for walking distances in peripheral arterial disease, and shows the superiority of the graded treadmill test on the six minute walk test and the Strandness test to analyze these improvements.



## ***INTRODUCTION***

Peripheral arterial disease (PAD) with claudication is a disable disease which affects 0.8 to 1.5% of the general population (23). It signs a bad evolution of a cardiovascular status, which imposes treatment. Rehabilitation is the first intention treatment of PAD with claudication, with risk factor mastering (35, 19). Initially proposed in the sixty's (28, 32), rehabilitation programs dedicated to patients with PAD have recently been proved effective (14, 13, 25, 35) and defined in guidelines, among which those of the American College of Cardiology/American Heart Association (21), the American Association of Cardiovascular and Pulmonary Rehabilitation (1), the American College of Sports Medicine (2), the French Health Authority (19). They recommend supervised exercise training, including walking treadmill exercises with complete rest between every exercises (6, 17). Patients walk up to pain evaluated at 3-4/5 (claudication pain scale), have complete rest, then walk again once pain completely disappears. These programs last from 6 weeks to 6 months, 3 to 5 days a week, with a minimum of 50 minutes of rehabilitation each day (including rest periods). A more intensive and shorter rehabilitation program might be interesting (34). This is the goal of the ARTEX clinical trial.

Since vascular claudication is the main symptom of PAD, the most relevant criterion for the diagnosis and patients' follow-up deals with walking ability, especially the distance walked before a maximal pain (cramp) requires stopping. Walking ability may be assessed by several ways: patients interview about their abilities (daily life), walking distance inside at a self-determined velocity during a given time on the floor, walking distance on a treadmill with fixed or adjusted velocity or slope, walking distance measured by an ambulatory monitoring. Interview may be open, structured or guided by a questionnaire. For PAD patients the most used questionnaire is the Walking Impairment Questionnaire, WIQ (33,35), which estimates the difficulties to walk several distances at various velocities, as well as abilities to climb stairs. The six minute walk test, 6MWT is the most used for assessing the walking distance inside at a self-determined velocity (3). Regarding the measurement of walking distances on a treadmill, the most famous test is the Strandness test, dedicated to PAD patients (31). This test may be termed constant test (C-test) due to the constant speed (3.2 km/h or 2 miles per hour) and slope (10 %). Graded tests (G-tests), initially proposed for the detection of ischemic heart disease (7), has been then adapted for PAD patients. Keeping the velocity of the

Strandness test (3.2 km/h), Gardner proposed a progressive test with a slope graded of 2% every 2 minutes (12) whereas Hiatt et al proposed a slope graded of 3.5% every 3 minutes (20). Progressive tests with weak slope increase walking distances, and overall the feasibility of the test in severe PAD patients (12). However approximately 15 % of PAD patients are not able to perform a progressive test with slope graded of 2% before therapeutic care (22). This fact points out the interest to design a novel progressive test with a weaker slope graduation. For all treadmill tests, results can be expressed as the initial claudication distance i.e. the distance walked until the claudication pain appears or the maximal claudication distance (MCD) corresponding to the distance walked until the test has to be stopped due to the maximal level of bearable claudication pain (27). MCD is usually the main criterion. Regarding the assessment of walking distances by ambulatory monitoring, various devices have been proposed such as pedometers (9), accelerometers (11), or GPS (Global Positioning System) (24). There is no consensus about the main relevant measurement for walking distances in patients with PAD (8), neither in clinical routine nor in research. Several measurements are usually reported, with the MCD mostly as the main criterion. There is thus a need to further comparatively analyse clinometric properties of these tests in PAD patients, especially the feasibility and responsiveness of treadmill tests.

This study had for objective to test the feasibility and responsiveness of several measurements of walking distances in PAD patients participating to a rehabilitation program.

## ***METHODS***

### **Search strategy**

This article is the first of the ARTEX study, a blind and randomized clinical trial aiming at comparing two rehabilitation programs of 4 weeks for patients with PAD, one based on intensive gait rehabilitation on treadmill with rest periods once reached the maximum pain, the other based on more continuous gait rehabilitation. Briefly, patients of the Artex Study perform 20 days of rehabilitation either in day hospitalization or in complete hospitalization, comprising general exercises and therapeutic education, in addition to a specific session of gait retraining on treadmill. The time period of care for each patient is 3 hours a day, 5 days a week during 4 weeks. The Artex study has been approved by our local ethical committee, and all patients included accepted and signed the informed consent form. For this metrological paper, we analysed data of the 19 first patients having completed the ARTEX study (36 to be included), without releasing the blindness.

### **Subjects**

Inclusion criteria were: Fontaine stage II PAD (confirmed by clinic, duplex ultrasound and ABI), age between 18 and 80 years, cardiac status compatible with an intensive gait rehabilitation. This specific point was checked by a consultation with a cardiologist, including interview, clinical examination, electrocardiograph, and effort test on ergocycle. Not inclusion criteria were: freedom private person by court or administrative order, patient being the object of a legal protective measure, exercise tolerance limited by other factors than claudication (eg, coronary artery disease, dyspnea, poorly controlled blood pressure), walking limited by other pathology, osteoarticular lower limbs pathology, abdominal aortic aneurysm > 4 cm, pseudo-flu-like feverish syndromes in evolution (myocarditis or pericarditis). Exclusion criteria were: impossibility to perform the protocol whatever reason. Any treatment was authorized, including beta blocker. No change of the treatment regularly prescribed was proposed. A control of cardiovascular risk factors was done before starting rehabilitation.

Patients' characteristics are presented in Table 1: mean age  $60.8 \pm 9.2$  years, 15 males (79%), body mass index (BMI)  $28.8 \pm 4.4$  kg/m<sup>2</sup>. More than half patients suffered from bilateral PAD.

## **Intervention**

According to randomization, patients were proposed a conventional rehabilitation program or an experimental rehabilitation program.

## **Measurements**

All patients were assessed before (Day 1) and after (Day 28) the rehabilitation program, during a whole day only dedicated to assessments (about 6 hours), during which an extensive set of cardiovascular, respiratory, gait, and psychological parameters was collected, in addition to general medical data.

Parameters regarding general medical information concerned medical history, the measurement of weight and blood pressure, location of arterial occlusion by duplex ultrasound and laterality of claudication pain, measurement and control of clinical and biological cardiovascular risk factors (obesity, tabagism, diabetes, renal insufficiency, dyslipidemia, arterial high blood pressure, systemic disease).

Three modalities of walking distance were assessed by the six minute walk test (6MWT) (3), a constant treadmill test (C test) (31), and by a graded treadmill test (G test), systematically in this order. As suggested by Gardner for PAD patients (16), the 6MWT was performed according to protocol described in guidelines (3) i.e. the test was performed after a 15 minutes rest then patients had to walk indoor at comfortable speed during 6 minutes. The C test was performed according to the original description by Strandness (31), at 3.2 km/h speed on a 10% slope. The maximal claudication distance (MCD) and ankle-to-brachial systolic blood pressure index (ABI) (4) were measured. ABI was measured both before (at rest) and after (1-

3 mn) the test. According to Meijer (26), the delta ABI was a variable defined as the difference between two measures (the most impaired side if bilateral). The G-test was performed at 3.2 km/h on a slope graduated by 0.5 % every 2 minutes until maximal pain. This procedure was derived from that proposed by Gardner et al (12) or Hiatt al (20), with a lower graduation of the slope: 0.5% for our test vs 2% for Gardner and 3.5% for Hiatt. We hypothesised this weak slope graduation might get the test more feasible in most severe patients showing a very limited walking distance. The maximal claudication distance (MCD) was measured. Both C and G tests were performed on a treadmill (TechmedPhysio<sup>R</sup>), allowing precise speed and slope adjustments. Handrail support was allowed during each treadmill test if it was necessary.

Cardiovascular and respiratory parameters measured were transcutaneous oxygen pressure (TcPO<sub>2</sub>) at rest and maximal cardiac frequency and peak oxygen consumption (VO<sub>2</sub>peak) during an additional treadmill effort test. TCPO<sub>2</sub> is a non-invasive method of partial pressure of oxygen measure on the foot skin surface, giving a direct indication onto the microcirculatory function (10). Foot TcPO<sub>2</sub> values were obtained with a Clarck-type polarographic electrode heated to 45°C to induce maximal vasodilatation of the dermal capillaries. The electrode was calibrated to the partial pressure of oxygen (PO<sub>2</sub>) present in room air, and was placed on the dorsum of the foot over the third cuneiform bone. The measure was made in stable hemodynamic conditions (after a supine position strict rest of twenty minutes). Duration of this examination was approximately thirty minutes. The treadmill effort test to measure the maximal cardiac frequency and VO<sub>2</sub>peak was a triangular effort test, performed by 2 minutes stages, with gaz exchange measurements and medical supervision until 6 mn after test end. This test lasted between 4 and 20 minutes. Stop criteria were: clinical anomaly (faintness, paleness, cold sweat, and thoracic pain), electrocardiogram anomalies (repolarisation or rhythm disorders).

The level of anxiety and depression was assessed using the Hospital Anxiety and Depression Scale (HADS) (5, 30), an ordinal scale well suited to PAD patients and often used in this context (29).

The only two missing values of this set of data were those corresponding to the HADS questionnaire and TcPO2 measures in one patient.

### **Statistical analysis**

Data were summarized in terms of size and frequency for categorical data and by means scores  $\pm$  standard deviation or median and 25<sup>th</sup>-75<sup>th</sup> percentiles for quantitative data. Independence between qualitative parameters was assessed using either the chi-square test or Fisher's exact test. Paired Student's *t*-test was used to compare continuous data. Wilcoxon tests were applied for non-Gaussian assumption. Correlations between parameters were evaluated by Spearman test. *P*-values <0.05 were considered statistically significant. All data analyses were performed using STATA release 12 (StataCorp, College Station, TX) PC-Software. Data are expressed in the form mean  $\pm$  SD [minimum; maximum].

## **RESULTS**

All patients managed to realize all walking tests and to finish the protocol, without side effect (any cardiovascular event, any fall).

### **Gait capacities at baseline**

Mean durations of tests were 6 mn for the 6MWT (by definition),  $5.8 \pm 7.05$  mn for the Strandness test [0.6; 30.7] and  $14.1 \pm 13.8$  mn for the G test [2, 42]. The distances walked were  $345.2 \pm 77.2$  m for the 6MWT,  $180 \pm 375.8$  m for the Strandness test, and  $420 \pm 818.6$  m for the G-test. These data are a first indication about the severity of the PAD in these patients.

The walking distances for the three walking tests were moderately correlated (Table 2), which means that they did not yield similar information. Regarding cardiovascular parameters, only VO<sub>2</sub> peak was correlated with the three walking tests (Table 2). The greater the VO<sub>2</sub> peak the greater the walking distance. Regarding psychological parameters, only depression HADS score was correlated with Strandness and G tests (Table 2). The more patients were depressive the lower the walking distance.

### **Improvements after the rehabilitation**

In average, all three walking distances increased after the rehabilitation. The improvements were 39.8 meters [-71; 188] for the 6MWT ( $p=0.017$ ), 190 meters [-180; 188] for the Strandness test ( $p=0.001$ ), and 720 meters [-530; 2770] for the G-test ( $p<0.001$ ). Individual data are presented in figure 1. The walking distance was improved for the three tests in 13/19 patients (68%). No patient worsened in the three tests. Improvements were dissociated in 6 patients, and 3 patients had similar results for two tests (Figure 1). The gain on the walking distance significantly differed between the three tests ( $p=0.001$ ): 11.5% for the 6MWT, 105.5% for the Strandness test, and 171.4% for the G test. The gain on the walking distance was much better for the G test than for the 6MWT ( $p<0.01$ ) and for the Strandness test ( $p=0.01$ ), and better for the Strandness test than for the 6MWT ( $p<0.05$ ).

We then analyzed the changes induced by the rehabilitation program on the five cardiovascular parameters. No significant change was found regarding the delta-ABI [ $0.32 \pm 0.12$  a.u. vs  $0.31 \pm 0.15$  a.u.;  $p=0.70$ ], TcPO<sub>2</sub> [ $29.6 \pm 15.8$  mmHg vs  $29.5 \pm 14.9$  mmHg;  $p=0.99$ ], the maximal cardiac frequency [ $114 \pm 17$  bpm vs  $118 \pm 20$  bpm;  $p=0.25$ ], or peak oxygen consumption [ $18.6 \pm 5.6$  mL/mn/kg vs  $19.7 \pm 5.8$  mL/mn/kg;  $p=0.17$ ]. This indicates that cardiovascular parameters measured were not significantly improved after rehabilitation.

Regarding the psychological parameters, improvements were found both for anxiety [ $6.6 \pm 4$  a.u. vs  $5.4 \pm 4$  a.u.;  $p < 0.05$ ] and depression [ $5.3 \pm 3.4$  a.u. vs  $4.4 \pm 2.9$  a.u.;  $p=0.015$ ] HADS scores.

### **Relationships regarding gains after rehabilitation**

Surprisingly no relationship was found between gains at the three walking tests. The correlations were as follows: 6MWT with Strandness test ( $r=-0.11$ ,  $p=0.75$ ) and G test ( $r=0.41$ ,  $p=0.24$ ), and between Strandness and G tests ( $r=0.38$ ,  $p=0.28$ ). This indicates that improvements on each walking test were independent, and that these 3 walking tests explore different aspects of gait abilities. Indeed, when possible relationships between gains in the three walking tests and gains in the cardiovascular or psychological parameters were sought, the gain for the 6MWT was found related only to the maximal cardiac frequency ( $r=0.65$ ,  $p < 0.05$ ) whereas the Strandness test was only found related only to the VO<sub>2</sub>peak increase ( $r=0.56$ ,  $p < 0.05$ ). No significant relationship was found for the G test.



## ***DISCUSSION***

The G-test used in this study was a new G-test, with a lower slope increase (0.5% every 2 minutes) than Gardner (12) or Hiatt (20) tests. This G-test seems easier and more adapted for patients suffering from severe PAD.

### **Responsiveness**

The results of this study confirm that there is an important increase of walking distance for patients with PAD after this walking program including rehabilitation 5 days a week during 4 weeks, for each treadmill test. The G-test had the most important responsiveness. Furthermore, G-test was always realized after 6MWT and Strandness test, thus the order of the tests cannot overestimate these results. The other walking tests correlated with cardiovascular parameters: distance gain during 6MWT was explained in part by cardiac frequency amelioration. Thus improve that cardiac frequency contribute in the increase walking distance during this test. Maximal distance gain during the Strandness test was explained in part by VO<sub>2</sub>peak amelioration. So the stop during Strandness test cannot be only connected to PAD, but also to a cardiorespiratory limit (low VO<sub>2</sub>peak). The Strandness test so appears to be too difficult for patients with low VO<sub>2</sub>peak. So, this test will be double limiting by calf pain and cardiorespiratory parameters.

On the other hand, maximal distance gain during the G-test is not explained by a cardiovascular parameter measured in this study. Maybe it could be explain by another parameter, like a metabolic or peripheral hemodynamic parameter, which were not really measured in this study. Thus to test PAD rehabilitation, it seems to be better to use this G-test (if we compare with 6MWT and Strandness test). These results agree with those of Gardner (12).

Furthermore, walking distance gains are not or little correlated between them: distance gain during the 6MWT is not correlated with maximal distance gain during the Strandness test and G-test, maximal distance gain during G-test is not correlated with maximal distance gain during the Strandness test and the 6MWT, and maximal distance gain during the Strandness test is not correlated with maximal distance gain during G-test and the 6MWT. These gains contain probably different information, and are explained by different things. So these three

tests seem to be independent, and it's necessary to realize all them in the evaluation of patients with PAD rehabilitation.

No significant change was found for ABI. Rehabilitation did not improve significantly TcPO<sub>2</sub> and V<sub>O<sub>2</sub>peak. So walking distance increases seem not to be explain by V<sub>O<sub>2</sub>peak, ABI or TcPO<sub>2</sub> changes. Maybe other cardiovascular and respiratory tests could explain that. These measures seem thus useless for PAD rehabilitation evaluation.</sub></sub>

### **Tests durations**

Never a study realized so many evaluations for each patient before and after rehabilitation, to evaluate clinical and cardiovascular parameters. Furthermore, this study is the only one to compare walking treadmill tests before, and after rehabilitation. Indeed, evaluations in this study lasted half a day for each patient: 6MWT (6 minutes + 15 minutes of rest before the test), Strandness test (1 to 37 minutes), G-test (2 to 42 minutes), effort test (4 to 20 minutes + 15 minutes of rest), TcPO<sub>2</sub> measure (30 minutes), and HADS questionnaire (15 minutes). So it represented about 6 hours for each patient, if we count rest periods. If we compare Strandness and G-tests durations, we shows that G-test is longer than Strandness test, as well before (14.1 vs 5.8 mn) than after rehabilitation (23.0 vs 11.6 mn). This is understandable because Strandness test is more difficult than G-test, because it begins in a 10 % slope, whereas G-test begins in a no slope (for the same velocity). It confirms that G-test seems to be pore adapted for patients with severe PAD.

### **Psychological improvement**

Our study is the first to use HADS for PAD patients before and after rehabilitation evaluation. We used it because the prevalence of depression ranges from 30 to 60 % in patients with PAD, this one increases with age, incapacities and pains (34). Furthermore, it is known that exercise ameliorate anxiety and depression (18). The results suggest that walking rehabilitation for PAD patients do not improve only walking distances but also has positive effects on psychological plan, in particular as regards anxiety and depression (significant increase of anxiety and depression HADS scores after rehabilitation). So HADS questionnaire seems to be indicated for PAD patient's evaluation before and after rehabilitation.

## **Possible limitations of the study**

The major limitation of this study is that for each treadmill test, patients were allowed to use handrail support. Because handrail support reduces the energy cost of treadmill walking, claudication and hemodynamic responses of patients with peripheral vascular occlusive disease should also be affected. Furthermore, Gardner showed in 1991 that claudication distances in treadmill tests were altered with use of handrail support (15). However, walking without handrail support was too difficult for a lot of our patients, so we decided to authorize patients to use handrail support.

Regarding ABI measurements, it was made in this study during a C-test (Strandness test), but it would be interesting to analyzed it before and after a G-test, to confirm that there is no change with rehabilitation.

Furthermore, this study concern only 19 patients with PAD, and should be confirmed by another study with larger population. However, this population seemed to be representative of PAD population (gender, mean age, and cardiovascular risk factors).

## ***CONCLUSION***

Walking distances have significant and important increase after walking rehabilitation, when walking capacities are measured with 6MWT, Strandness test and a G-test. G-test seems to have a more important responsiveness than the other tests (6MWT and Strandness test), and seems to be more adapted for patients with PAD, because it did not correlated with a cardiovascular parameter. Walking distances are not correlated in these tests, so each test is independent and has to be realized. Furthermore, PAD rehabilitation also improved patients on the psychological plan (anxiety and depression), and the HADS questionnaire should be used in clinical trials of rehabilitation for patients with PAD. These results have to be confirmed by another study with larger population.

## TABLES

**Table 1** – Patients' characteristics. Mean  $\pm$  Standard deviation; extreme values or percentages in brackets

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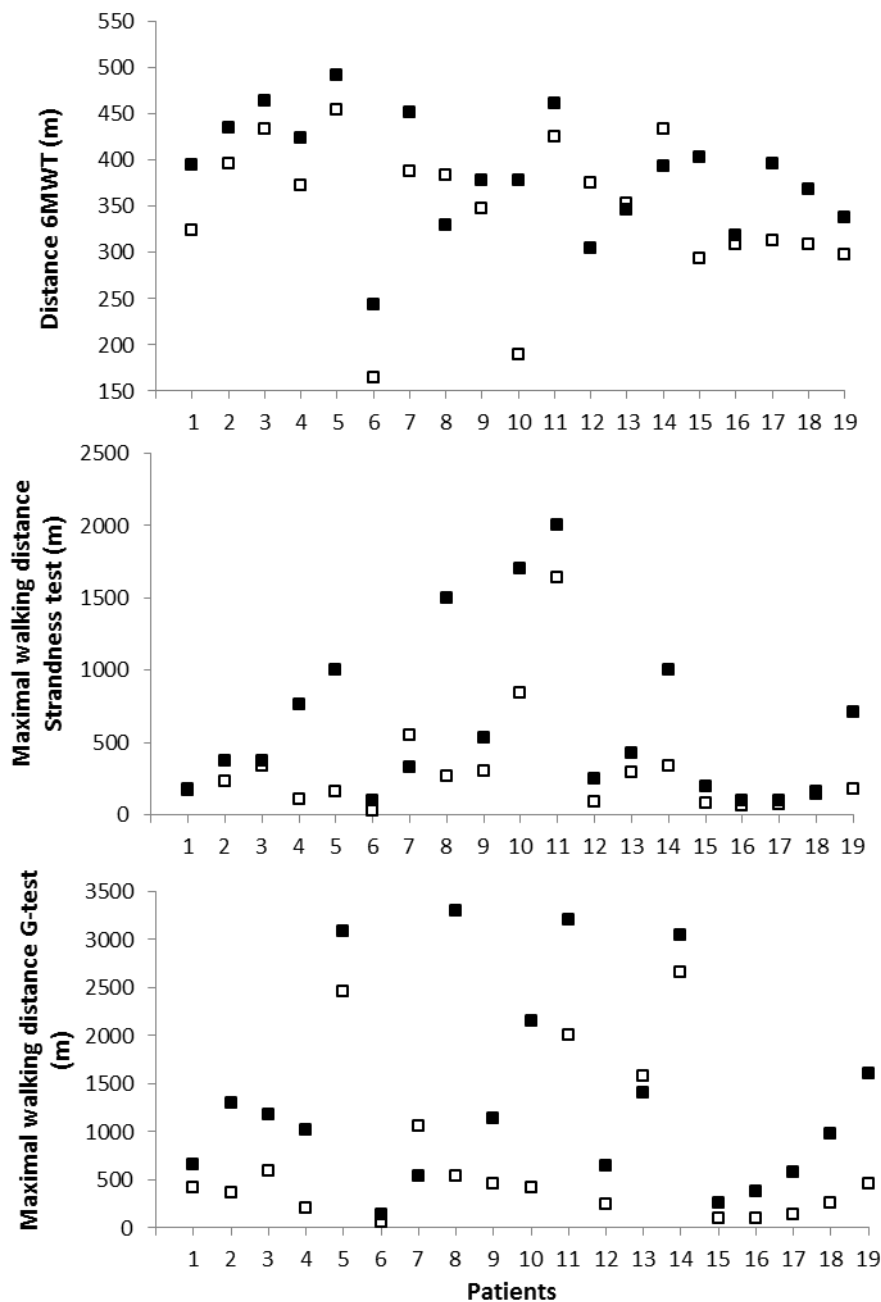
Age (years)	60.8 $\pm$ 9.2 (46 ; 76)
Gender (Male)	15 (79 %)
BMI (kg/m <sup>2</sup> )	28.8 $\pm$ 4.4 (20.8 ; 35.1)
Current smoker	18 (94.7 %)
Former smoker	13 (68.4 %)
Alcoholism recognized	1 (5.2 %)
Systemic disease	2 (10.5 %)
Diabetes	10 (52.6 %)
Insulin-dependent	2 (10.5 %)
Arterial high blood pressure	15 (79 %)
Renal insufficiency	5 (26.3 %)
Dyslipemia	15 (79 %)
PAD laterality	
Right	6 (31.6 %)
Left	3 (15.8 %)

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**Table 2-** Correlations at D1 between 6MWT distance, Strandness test (Strd test) distance, Gtest distance, ABI difference, TcPO2, Maximal cardiac frequency (Maximal CF), VO2 peak, HADS Anxiety and Depression

	Distance - 6MWT	Distance - Strd test	Distance - Gtest	ABI difference	TcPO2	Maximal CF	VO2 peak	HADS Anxiety
<b>Distance - Strd test</b>	0.46 (p=0.05)							
<b>Distance - Gtest</b>	0.60 (p=0.001)	0.62 (p=0.01)						
<b>ABI difference</b>	-0.12 (p=0.63)	-0.08 (p=0.76)	-0.08 (p=0.74)					
<b>TcPO2</b>	-0.22 (p=0.37)	-0.09 (p=0.73)	-0.24 (p=0.34)	-0.07 (p=0.79)				
<b>Maximal CF</b>	0.32 (p=0.19)	0.38 (p=0.12)	0.17 (p=0.49)	0.06 (p=0.81)	-0.06 (p=0.80)			
<b>VO2 peak</b>	0.65 (p=0.003)	0.72 (p=0.001)	0.71 (p=0.001)	-0.03 (p=0.92)	-0.11 (p=0.66)	0.59 (p=0.01)		
<b>HADS Anxiety</b>	-0.38 (p=0.12)	-0.38 (p=0.12)	-0.30 (p=0.22)	0.25 (p=0.31)	-0.20 (p=0.43)	-0.07 (p=0.79)	-0.27 (p=0.28)	
<b>HADS Depression</b>	-0.21 (p=0.39)	-0.58 (p=0.01)	-0.49 (p=0.04)	0.001 (p=0.99)	-0.21 (p=0.41)	-0.32 (p=0.19)	-0.32 (p=0.19)	0.67 (p=0.002)

**Figure 1-** Individual data in the 19 patients for the three walking tests before (□) and after (■) rehabilitation. The walking distance was improved for the three tests in 13/19 patients (68%). 3 patients (P8, P12 and P14) were improved at Strandness and G tests but not at 6MWT, 1 patient (P1) improved at 6MWT and G test but not at Strandness test, 1 patient (P7) was improved at 6MWT only, and 1 patient (P13) was improved at Strandness test only. 3 patients had similar results for two tests (defined by difference <10%): one (P3) for 6MWT (7.2%) and Strandness test (8.8%), one (P13) for 6MWT (-1.98%) and G test (-11.4%), and one (P18) for 6MWT (19.5%) and Strandness test (14.3%).



## ***RESUME DE LA THESE***

### DIFFERENTES MODALITES D'EVALUATION DE LA DISTANCE DE MARCHE CHEZ L'ARTERIOPATHE CLAUDICANT : SENSIBILITE AU CHANGEMENT APRES REEDUCATION

Mots clés : Artériopathies des membres inférieurs, claudication, évaluation, test de marche, rééducation

**Objectifs :** L'artériopathie des membres inférieurs symptomatique touche 0,8 à 1,5% de la population générale, et le traitement médical de première intention est la rééducation à la marche. Il n'existe aucun consensus sur la manière d'évaluer cette rééducation. Cette étude a pour objectif de tester la sensibilité au changement de plusieurs modalités d'évaluation de la distance de marche, ainsi que d'autres paramètres.

**Matériels et méthode:** Cette étude porte sur les 19 premiers patients inclus dans l'étude AR-TEX (essai clinique de rééducation à la marche pour artériopathe claudicant). Avant et après 4 semaines de rééducation, ces patients ont bénéficié des évaluations suivantes : distances de marche évaluées par le test de marche des 6 minutes, le test de Strandness (vitesse et pente constantes) et un test de marche avec pente incrémentielle, ainsi que des paramètres physiologiques (pression transcutanée en oxygène, index de pression systolique, fréquence cardiaque maximale et consommation maximale d'oxygène), et psychologiques (Hospital Anxiety and Depression Scale questionnaire).



**Résultats :** Les tests significativement améliorés après la rééducation étaient: test de marche des 6 minutes (345.2+-77.2 mètres vs 385+-62.6,  $p<0.05$ ), test de Strandness (310.5+-375.8 vs 620+-755,  $p=0.001$ ), test de marche incrémentiel (741.6+-818.6 vs 1397.9+-1054.6,  $p<0.001$ ), et score d'anxiété et dépression de l'HADS questionnaire (6.5+-3.9 vs 5.4+-4.0,  $p<0.05$  pour le score d'anxiété, et 5.3+-3.3 vs 4.4+-2.9,  $p<0.05$  pour le score de dépression). Parmi les tests de marche, le test incrémentiel était celui qui avait la plus grande sensibilité au changement (171,4%, vs 105,5% pour le test de Strandness, et 11,53% pour le test de marche des 6 minutes).

**Conclusion :** Cette étude confirme le bénéfice important de la rééducation pour la distance de marche chez le patient artériopathe, et montre la supériorité du test incrémentiel sur le test de marche des 6 minutes et le test de Strandness pour analyser ces améliorations.

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## ***ABBREVIATIONS***

**ABI:** ankle-to-brachial systolic blood pressure index

**BMI:** Body Mass Index

**C-test:** Constant test

**GPS:** Global Positioning System

**G-test:** Graded test

**HADS:** Hospital Anxiety and Depression Scale

**ICD:** Initial Claudication Distance

**MCD:** Maximal Claudication Distance

**PAD:** Peripheral Arterial Disease

**PO<sub>2</sub>:** Partial pressure of oxygen

**6MWT:** six minute walk test

**TcPO<sub>2</sub>:** Foot transcutaneous oxygen tension

**VO<sub>2</sub>peak:** peak oxygen consumption

**THESE SOUTENUE PAR : GAILLED RAT Elodie**

**TITRE : « DIFFERENTES MODALITES D'EVALUATION DE LA DISTANCE DE MARCHE CHEZ L'ARTERIOPATHE CLAUDICANT : SENSIBILITE AU CHANGEMENT APRES REEDUCATION »**

### **CONCLUSION**

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VU ET PERMIS D'IMPRIMER

Grenoble, le 15/10/2012

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CROIZE	Jacques	Bactériologie-virologie
DERANSART	Colin	Physiologie
DETANTE	Olivier	Neurologie
DUMESTRE-PERARD	Chantal	Immunologie
EYSSERIC	Hélène	Médecine légale et droit de la santé
FAURE	Julien	Biochimie et biologie moléculaire
GILLOIS	Pierre	Biostatistiques, informatique médicale et technologies de communication
GRAND	Sylvie	Radiologie et imagerie médicale
HENNEBICQ	Sylviane	Biologie et médecine du développement et de la reproduction
HOFFMANN	Pascale	Gynécologie-obstétrique
LABARERE	José	Epidémiologie, économie de la santé et prévention
LAPORTE	François	Biochimie et biologie moléculaire
LARDY	Bernard	Biochimie et biologie moléculaire
LARRAT	Sylvie	Bactériologie-virologie
LAUNOIS-ROLLINAT	Sandrine	Physiologie

<b>MALLARET</b>	Marie-Reine	<b>Epidémiologie, économie de la santé et prévention</b>
<b>MAUBON</b>	Danièle	<b>Parasitologie et mycologie</b>
<b>MC LEER (FLORIN)</b>	Anne	<b>Cytologie et histologie</b>
<b>MOREAU-GAUDRY</b>	Alexandre	<b>Biostatistiques, informatique médicale et technologies de communication</b>
<b>MOUCHET</b>	Patrick	<b>Physiologie</b>
<b>PACLET</b>	Marie-Hélène	<b>Biochimie et biologie moléculaire</b>
<b>PASQUIER</b>	Dominique	<b>Anatomie et cytologie pathologiques</b>
<b>PAYSANT</b>	François	<b>Médecine légale et droit de la santé</b>
<b>PELLETIER</b>	Laurent	<b>Biologie cellulaire</b>
<b>RAY</b>	Pierre	<b>Génétique</b>
<b>RIALLE</b>	Vincent	<b>Biostatistiques, informatique médicale et technologies de communication</b>
<b>SATRE</b>	Véronique	<b>Génétique</b>
<b>STASIA</b>	Marie-Josée	<b>Biochimie et biologie moléculaire</b>
<b>TAMISIER</b>	Renaud	<b>Physiologie</b>

## **SERMENT D'HIPPOCRATE**

*En présence des Maîtres de cette Faculté, de mes chers condisciples et devant l'effigie d'HIPPOCRATE,*

*Je promets et je jure d'être fidèle aux lois de l'honneur et de la probité dans l'exercice de la Médecine.*

*Je donnerai mes soins gratuitement à l'indigent et n'exigerai jamais un salaire au-dessus de mon travail. Je ne participerai à aucun partage clandestin d'honoraires. Admis dans l'intimité des maisons, mes yeux n'y verront pas ce qui s'y passe ; ma langue taira les secrets qui me seront confiés et mon état ne servira pas à corrompre les mœurs, ni à favoriser le crime.*

*Je ne permettrai pas que des considérations de religion, de nation, de race, de parti ou de classe sociale viennent s'interposer entre mon devoir et mon patient.*

*Je garderai le respect absolu de la vie humaine.*

*Même sous la menace, je n'admettrai pas de faire usage de mes connaissances médicales contre les lois de l'humanité.*

*Respectueux et reconnaissant envers mes Maîtres, je rendrai à leurs enfants l'instruction que j'ai reçue de leurs pères.*

*Que les hommes m'accordent leur estime si je suis fidèle à mes promesses.*

*Que je sois couvert d'opprobre et méprisé de mes confrères si j'y manque.*