



SCOTTISH PHYSIOTHERAPY  
AMPUTEE RESEARCH GROUP

# **Exercise Intervention for the Treatment of Patients with Intermittent Claudication**

(Update of SPARG review guideline published in 2012)

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### **Author's note**

At the time of finishing this document we are 20 months into the CoViD 19 pandemic. Physiotherapy services nationwide have been hugely disrupted with resources being redeployed and non-essential services greatly reduced and even terminated in some areas. Intermittent claudication programs were stopped and only now is the service starting to open up in NHS Highland. Face to face appointments are happening but the weekly exercise class is yet to resume.

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## **The Guideline Review Group**

The guideline review group (author and peer reviewers) is a sub-group of the Scottish Physiotherapy Amputee Research Group (SPARG) which is a special interest group. SPARG runs a national audit project, encourages research and development and acts as a forum for discussion and debate primarily in the field of amputee rehabilitation. In Scotland physiotherapists often have a dual responsibility for both amputee rehabilitation and the treatment of patients with peripheral arterial disease (PAD). These physiotherapists are all active members of SPARG.

The Cochrane Collaboration first published a report in 1998 which concluded that exercise classes should be the treatment of choice for patients with intermittent claudication (IC), that is, early stage vascular disease. Subsequent Cochrane Reviews in 2008 and 2018 confirmed this recommendation and suggested that it was vital to promote exercise therapy and the role of physiotherapists. Currently, Scotland has 3 centres which provide a claudication service – NHS Highland, NHS Ayrshire and Arran and NHS Lanarkshire.

In 2002 a subgroup of SPARG was convened to write evidence based guidelines for the development and running of exercise classes for intermittent claudication. That document was reviewed in 2012. This document is an updated version of the 2012 review. The key recommendations from the 2012 document are still relevant.

### **Objectives of the review group**

- To up-date the existing guideline review by conducting a review using DYNAMED and similar systems which are up to date and current
- To seek multidisciplinary peer review and approval of the guideline.

### **Method of review of the guideline**

The Knowledge Network is the national knowledge management platform for health and social care in Scotland. It is developed and maintained by the Knowledge Services group at NHS Education for Scotland.

After consultation with the Raigmore Hospital librarian and in conjunction with The Knowledge Network it was deemed best practice to use the new methods of Dynamed and similar systems. These systems are current and continually updated as new articles are submitted.

### **Search methods for current evidence :**

- Dynamed    The Knowledge Network
- BMJ        The Knowledge Network
- UpToDate   NHS Highland

## **Dynamed — Mission Statement**

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Every day at DynaMed, a multidisciplinary team of physicians and methodologists comb emergent scientific literature with a view to identifying clinically-relevant information, determining its reliability, and synthesizing it into the current body of knowledge presented on DynaMed. Additionally, clinical practice guidelines from across the globe are monitored daily and incorporated into DynaMed's content.

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# INTERMITTENT CLAUDICATION

## Epidemiology

The incidence of peripheral arterial disease increases with age. Population studies have found that about 20% of people aged over 60 years have some degree of peripheral arterial disease. Incidence is also high in people who smoke, people with diabetes and people with coronary artery disease. In most people with intermittent claudication the symptoms remain stable, but approximately 20% will develop increasingly severe symptoms with the development of critical limb ischaemia. Overall approximately 1-2% of people with intermittent claudication will eventually undergo amputation, although the risk is higher (about 5%) in people with diabetes.

Of those presenting with intermittent claudication over a 5-year period approximately 70 - 80% will remain with stable claudication, 10 – 20% will go on to have worsening symptoms and 5 – 10% will go on to develop critical limb ischaemia. Approximately 10 – 15% will die of cardiovascular causes within 5 years and a further 20% will have a non-fatal cardiovascular event. Of those who develop critical limb ischaemia there is a high mortality with approximately 25% dying within a year and about 1/3 will require a major lower limb amputation within a year.

(NICE guidelines 2013)

## What is Intermittent Claudication?

Pain within a defined group of muscles that is induced by exercise and relieved with rest defines classic intermittent claudication (derived from the Latin word for limp). The severity of claudication symptoms reported by the patient depends upon the degree of stenosis, the effectiveness of collateral vascular channels, and the vigor of exercise. The perception of claudication can range from a bothersome discomfort of little consequence to a severe, debilitating pain that becomes lifestyle limiting.

Classic symptoms of claudication manifest as exertional leg pain that begins after a certain walking distance, causes the patient to stop walking, and resolves with rest, allowing the patient to resume walking again. Claudication can present unilaterally or bilaterally, as buttock and hip, thigh, calf, or foot pain, singly or in combination. The usual relationships between pain location and corresponding anatomic site of PAD are as follows:

- Buttock and hip claudication – Patients with aortoiliac disease may complain of buttock, hip, and, in some cases, thigh claudication. The pain is often described as aching in nature and may be associated with weakness of the hip or thigh with walking. Pulses in one or both groins are diminished.
- Thigh claudication – Atherosclerotic occlusion of the common femoral artery may induce claudication in the thigh, calf, or both. Patients with disease isolated to the superficial femoral or popliteal arteries have normal groin pulses but decreased pulses distally.
- Calf claudication – this is the most common complaint. It is usually described as escalating pain that is consistently reproduced with exercise and relieved with rest. Pain in the upper two-thirds of the calf is usually due to superficial femoral artery stenosis, whereas pain in the lower third of the calf is due to popliteal disease.

## **Diagnosis of Intermittent Claudication**

PAD is often under-recognised and under-treated. Many patients with PAD are asymptomatic, but will have 1 or more risk factors. The resting ankle-brachial index (ABI) is the initial diagnostic test for PAD. It is recommended in all patients with suspected lower limb disease with a history of exertional leg symptoms, non-healing wounds/foot ulcers, or abnormal lower extremity pulse examination

An accurate diagnosis of IC is necessary to exclude patients that present with leg pain due to conditions other than IC, for example, arthritic pain, sciatic nerve pain. Diagnosis is made by description of symptoms i.e. pain occurring in the calf and / or thigh associated with exercise and relieved by rest, clinical examination, measurement of impaired walking distances and Ankle Brachial Pressure Index (ABPI) of less than 0.9 at rest that decreases to less than 0.73 after exercise.

ABPI measurements have been found to be highly reliable, 95% sensitive to angiogram positive disease and valid when correlated with pre-intervention limitations in walking distances due to IC. The magnitude of the ratio has also been shown to correlate with the severity of disease. A drop in ABPI post exercise and a lengthy recovery time is recommended as further confirmation of a diagnosis of IC. ABPI do not correlate with post intervention changes in walking distances and therefore their use is not recommended as an outcome measure.

ABPI may not be accurate in patients with non-compressible arteries (e.g., patients with long standing diabetes mellitus, or renal patients on dialysis).

Exercise treadmill tests with measurement of ABPI before and after exercise are recommended to provide diagnostic data useful in differentiating arterial claudication from non arterial claudication.

A treadmill walking test or appropriate alternative should be performed to allow accurate measurement of the distance at which the claudication pain starts, that is, the pain onset distance (POD) and the distance at which the pain stops walking, that is, the maximum walking distance (MWD).

Once a patient is diagnosed with claudication due to peripheral artery disease (PAD), a rational approach to treatment takes into account the patient's age and medical comorbidities, daily activities and limitations, severity of symptoms, and location and extent of disease.

Most patients with a diagnosis of claudication should be treated initially with a medical therapy regimen because PAD reflects a systemic disease of atherosclerosis and must include risk factor modification and exercise therapy (ideally supervised exercise therapy) and pharmacologic therapy.

## **Differential Diagnosis**

There are a few conditions which can mimic IC

### **Spinal stenosis**

Signs:

Patients with history of back pain complain of hip, thigh, buttock, or leg pain. It is usually in a dermatomal distribution and may be associated with motor weakness. The pain may occur on standing alone and is relieved by position change such as sitting or stooping forwards (lumbar spine flexion).

Tests:

- Ankle brachial pressure index (ABPI) will be normal and exercise ABPI will show no decrease in post-exercise ABPI
- No significant disease seen with arterial imaging tests
- Plain spinal x-ray: degenerative changes or spondylolisthesis
- MRI spine: compression of the neural elements and soft tissue

### **Arthritis**

Signs: Patients complain of hip, thigh, or buttock pain that is localised to hip and gluteal region. It can occur at rest or starts after exercise and is not quickly relieved.

Tests:

- Ankle brachial index (ABPI) will be normal and exercise ABPI will show no decrease in post-exercise ABPI
- No significant disease seen with arterial imaging tests
- X-ray of affected joint: new bone formation (osteophytes), joint space narrowing, and subchondral sclerosis and cysts

### **Venous claudication**

Signs:

Patients often have a history of iliofemoral deep venous thrombosis, signs of venous congestion, and oedema. They may complain of entire leg pain that is usually worse in the thigh and groin region. The pain is described as tight or bursting, and starts after walking and is relieved slowly. Pain relief usually occurs once the leg is elevated.

Tests:

- Ankle brachial index (ABPI) will be normal and exercise ABPI will show no decrease in post-exercise ABPI
- No significant disease seen with arterial imaging tests

### **Chronic compartment syndrome**

Signs:

Occurs in athletes. They complain of tight bursting calf pain after exercise that subsides slowly after leg elevation. Usually these patients are very muscular.

Tests:

- Duplex ultrasound scanning will show no significant arterial stenosis
- Compartment pressure measurement: differential pressure  $\leq 20$  mmHg

### **Symptomatic Baker's cyst**

Signs:

Patients complain of pain in the calf and behind the knee. The area may be swollen, sore, and tender. The pain is present at rest and worse with exercise.

Tests:

- Ankle brachial index (ABPI) will be normal and exercise ABPI will show no decrease in



- post-exercise ABPI
- No significant disease seen with arterial imaging tests Duplex ultrasound of the leg: cystic mass in the posterior medial popliteal

### **Nerve root compression**

Signs:

Patients have pain that radiates down the leg. Often have a history of back problems.

Tests:

- Ankle brachial index (ABPI) will be normal and exercise ABPI will show no decrease in post-exercise ABPI
- No significant disease seen with arterial imaging tests

## **Risk Factor Assessment**

All patients regardless of their symptoms should have aggressive risk factor modification. Since patients with PAD have significantly increased cardiovascular mortality and morbidity, it is crucial to modify cardiovascular risk factors. Risk factor modifications should include control of blood pressure, diabetes, and cholesterol and smoking cessation. Since the most common aetiology of PAD is atherosclerosis, the risk factors for PAD are similar to those of coronary artery disease (CAD).

### **Smoking**

Smoking is 2 or 3 times more likely to cause PAD than CAD. Smoking is the most powerful predictor and is independently associated with the development of PAD; an almost 4-fold increased risk of PAD due to smoking has been reported. Additionally, a dose-dependent association between smoking and the severity of PAD has been supported. Both active and passive cigarette smoking impair flow-mediated endothelium-dependent peripheral arterial vasodilation (arterial stiffness). Smoking cessation is therefore essential to prevent disease progression, as well as to decrease clinical deterioration (i.e., walking distance) and amputation rates.

### **Diabetes**

Diabetes has been shown to increase the risk of PAD by 2- to 4-fold. Diabetes increases the risk of intermittent claudication by 3- to 9-fold. The risk is proportional to the severity and duration of diabetes. Patients with both PAD and diabetes are 7 to 15 times more likely to undergo limb amputation. The UK Prospective Diabetes Study Group showed that each 1% increase in glycosylated haemoglobin levels is associated with a 28% increased risk of incident PAD and with a 28% increased risk of death, independent of other variables, such as blood pressure, serum cholesterol, age, or smoking status. Thus, aggressive control of hyperglycaemia in diabetes mellitus is essential to prevent disease progression and reduce cardiovascular risk. The patient must be educated on the effects of exercise on diabetes.

### **Hypertension**

Hypertension is a recognised risk factor for PAD. In the Framingham Heart Study, PAD was increased by the severity of hypertension and the risk of intermittent claudication overall was increased 2- to 4-fold. An even higher population risk attributable to hypertension of 41% was reported in the Health Professionals Follow-up Study. Risk factor modifications should include control of blood pressure.

### **Hyperlipidaemia**

Elevated total cholesterol, low-density lipoprotein (LDL), triglycerides, and lipoprotein (a) have been associated with increased risk of PAD. Decreased levels of high-density lipoprotein have also been associated with increased risk. Aggressive pharmacological management of lipid abnormalities in

patients with PAD (e.g., with statins) is crucial.

## **EXERCISE THERAPY**

Exercise as a treatment for IC is not a novel idea. The positive effects of exercise with this category of patients have been researched and reported since 1966. A Cochrane Library systematic review and meta-analysis has concluded that exercise programmes were of significant benefit compared with placebo or usual care in improving walking time and distance in selected patients with IC. The Scottish Intercollegiate Guidelines Network (SIGN) reinforced this with the statement that patients with IC should be encouraged to exercise.

The benefits of exercise for patients with IC are:-

- The ability to walk further before the onset of pain (pain onset distance)
- The ability to walk further before the pain becomes unbearable (maximum walking distance)
- Improvement in community based function
- Improved quality of life

Regular exercise has been shown to reduce the risk of future cardiovascular disease, improve health and promote a sense of wellbeing in the general population. Indeed, the importance of physical activity in improving the health of people with long term conditions such as vascular disease is widely recognized.

### **Mechanisms for the improvement in exercise performance**

There are several mechanisms by which exercise training may improve claudication, although the available data is insufficient to make conclusions regarding the relative importance of each:

- Increased calf blood flow
- Improved endothelial function increases endothelial-dependent dilation
- Reduced local inflammation (induced by muscle ischaemia) by decreasing free radicals

- Improvements in muscle architecture
- Improved muscular strength and endurance, and increased exercise pain tolerance
- Induction of vascular angiogenesis – collateral vessels
- Improved mitochondrial and muscle function and muscle metabolism
- Reduced red cell aggregation and blood viscosity

### **Adverse cardiovascular incidents**

No randomized trials were found evaluating the effect of exercise on mortality or cardiovascular events in adults with high risk of cardiovascular disease.

Exercise has been proven to be a relatively risk free treatment compared with surgical intervention. However, physiotherapists working with these patients need to be aware that patients with IC present as a population with a high prevalence of cardiovascular and cerebrovascular co-morbidities and a comparable risk profile for exercise prescription as patients with other types of cardiovascular disease. Physiotherapists have to be aware of the implications of exercise in this group of patients. Patients should be encouraged to monitor and adjust their exertion levels using a subjective perception of activity level.

### **Co-morbidities**

People with IC are often elderly and have other pre-existing medical conditions which could compromise an exercise program.

### **Musculoskeletal injury**

Musculoskeletal injury is a potential risk of any exercise intervention. A warm-up and cool down session, including stretches could be considered to reduce the risk of these injuries.

## **Inclusion/Exclusion Criteria**

The following criteria are recommended to ensure that the health benefits of exercise with this category of patients outweigh any potential risks. These criteria are also written to guide appropriate referral and therefore ensure the best use of resources.

Fontaine's classification is a method by which the spectrum of symptoms of peripheral artery disease is clinically classified.

<b>Stage</b>	<b>Definition</b>
I	Asymptomatic
IIa	Mild IC. Walking distance > 200m
IIb	Moderate to severe IC. Walking distance < 200m
III	Nocturnal and / or rest pain
IV	Ischaemic ulcers / gangrene

These recommendations of the entry and exclusion criteria are based on the previous guidelines and the author's clinical experience.

### **Inclusion criteria for exercise class**

## Diagnosis of IC confirmed

- Clinical examination – usually a 3 month history of pain in calf and / or thigh brought on by exercise and relieved by rest
- ABPI less than 0.9 at rest decreasing to less than 0.73 after exercise
- Walking test to ascertain POD and MWD
- Fontaine classification of IIa and IIb

## Diabetic patients

- Suitable for inclusion but must have education about effects of exercise on diabetic control

## Risk factor assessment

- Risk factor modification and motivational interviews regarding this are essential

## Assessment of suitability for exercise class

- Cognitive state
- Co-morbidities
- IC should be the main limiting ability
- Consideration of the distance required to travel to attend the class

## Exclusion criteria for exercise class

- Poorly controlled hypertension
- Critical ischaemia with rest pain +/- tissue loss
- Unstable angina / cardiac condition
- Impaired cognitive status
- Disinclination to participate in an exercise class
- Any other factors which prevent exercise participation

## Types and Prescription of Exercise

Patients with peripheral arterial disease have impaired muscle strength and walking ability, resulting in progressive functional impairment and poorer quality of life. Leg strength is linearly correlated with lower extremity ankle-brachial index and with functional performance in patients with peripheral artery disease.

Despite the evidence of benefit, issues remain concerning the optimal regimen for exercise rehabilitation. In general, exercise should be performed for a minimum of 45 to 60 minutes at least three times per week for a minimum of 12 weeks. During each session, an exercise level that is of sufficient intensity to elicit claudication should be achieved.

## Treadmill Exercise Program

From the evidence supervised exercise programs generally consist of a series of sessions lasting 45 to 60 minutes per session, using a treadmill. Including warm-up and cool-down periods of 5 to 10 minutes each, the initial session usually includes 35 minutes of intermittent

walking. Walking is then increased by five minutes each session until 50 minutes of intermittent walking can be accomplished. Ideally, the patient attends at least three sessions per week, with a program length greater than three months. Each session is supervised on a one-to-one basis by a physiotherapist, or nurse. The supervisor monitors the patient's claudication threshold and other cardiovascular parameters. Most patients who eventually respond to a supervised exercise protocol can expect improvement within two months, but the benefits of exercise diminish if exercise training stops.

## **Circuit Exercise Program**

Cardiovascular exercises and walking should be used in combination with weight bearing exercises to increase cardio respiratory fitness and walking capacity.

A home exercise programme and advice on risk factor modification should be an essential component of the class.

The circuit can consist of as many stations as the physiotherapist thinks appropriate. It should include at least one that involves walking and the rest should work the main muscle groups of the lower limb. The intensity can be varied by increasing the time spent at each station or increasing the exercise speed. As before the patients exercise to near maximal pain. They then stop, rest and restart once the pain subsides.

Warm up – a gentle walk

Examples of exercise stations

- step ups
- walking - treadmill +/-or corridor
- sit to stand or mini squats
- heel raises
- marching on the spot
- exercise bike/cross trainer
- upper limb strengthening exercise

Cool down – a gentle walk

Stretches for all the main muscle groups

Ideally a class should run 1-2 times a week for a minimum period of 3 months. This requires a venue and appropriate number of staff for health and safety. It is not as labour intensive as the treadmill program

## **Alternative modes of exercise**

Although most trials have used lower extremity exercise (e.g., treadmill or walking), other forms of exercise have been investigated for improving walking performance in patients with PAD. These include upper limb ergometry, cycling and resistance/strength training. For patients with claudication who cannot participate in a walking program, an alternative strategy for exercise therapy can be used, which can be beneficial for improving walking ability and functional status. The optimal intensity of exercise is uncertain.

There was no clear evidence of differences between supervised walking exercise and alternative exercise modes in improving the maximum and pain-free walking distance of patients with intermittent claudication. More studies with larger sample sizes are needed to make meaningful comparisons between each alternative exercise mode and the current

standard of supervised treadmill walking. The results indicate that alternative exercise modes may be useful when supervised walking exercise is not an option for the patient. From the author's experience a treadmill walking program on a 1:1 basis is not a practical or time sensitive option. A supervised exercise class comprising a circuit of exercises with a home based exercise program is a more effective mode of delivering treatment.

Supervised exercise programs are suggested to have clinically relevant benefits compared with non-supervised regimens although home based unsupervised programs with support have also proven beneficial.

A home walking program should be given in conjunction with a class program as walking more than 3 times a week for exercise is associated with less functional decline in a year compared with patients who walk less frequently.

It has been suggested that Nordic pole walking may help patients with intermittent claudication to increase their walking distance.

## **Frequency & duration of exercise**

In most studies, supervised exercise programmes involve treadmill or track walking that is of sufficient intensity to bring on claudication pain. Walking exercise is alternated with rest over the course of a 30- to 60-minute session. Exercise therapy for IC is recommended at least three times a week for three months, although there does not seem to be a clear dose-response relationship between exercise volume or intensity and symptom relief. Unfortunately, some groups of patients with IC are not capable of completing the exercise protocol because of concomitant comorbidities, such as arthritis, chronic obstructive pulmonary disease, stroke, or cardiac complaints. For these patients, an adjusted protocol or alternative exercise regime may be proposed.

Examination of the literature showed that improvements in walking capacity have been demonstrated after as short a training period as six weeks. However exercise classes were shown to be most beneficial when run for 2 to 3 times a week for at least 3 to 6 months although in practice this may not be easily achievable.

## **Resource implications**

Exercise therapy is thought to be more cost effective and beneficial in the long term for patients with early PAD than surgical intervention. It would appear to be less expensive and carry fewer risks than revascularisation surgery which has been associated with an operative mortality of 4% and adverse incidents of 18%. However, there is little evidence in the literature regarding the specific costs of an exercise service.

It is acknowledged that there will be resource implications in the implementation of an exercise therapy program.

## **Outcome Measures**

Outcome measurement is used to assess the effects of treatment interventions. An outcome measure must be valid, reliable, sensitive to change and feasible to use. The goals of the treatment of IC are the relief of pain, improvement in walking performance, improvement in community based function and quality of life. The effectiveness of exercise therapy should be measured using these as outcomes.

Ideally, outcomes should be measured before treatment, after three months of treatment, 6 months and one year after discharge.

### **Measurement of walking distance - Objective OMs**

#### **Treadmill test**

The most commonly used parameters for the evaluation of changes in walking performance are the Pain Onset Distance (POD) and Maximum Walking Distance (MWD), measured using a constant load treadmill test or, preferably, a graded incline treadmill test.

Advantages of the graded incline treadmill test

- easily reproducible and comparable
- accurate for POD and MWD
- tends to produce claudication symptoms quicker than the shuttle test

Disadvantages of the Treadmill test

- Can be intimidating for the patient who may fear falling and /or managing the walking speed
- They do not reflect the patient's ability to walk in the non laboratory setting

#### **Shuttle Corridor Walk Test**

The author has found that claudication patients were failing the shuttle test as they were unable to keep up with the increases in speed required to match the beeps. Their

claudication distance was not achieved therefore meaningful data was not gathered regarding POD and MWD.

If a patient can clearly not manage the treadmill the 10m shuttle distance can be used without the beeps.

## **Measurement of walking distance - Subjective OM**

### **The Walking Impairment Questionnaire (WIQ)**

The Walking Impairment Questionnaire (WIQ) has been developed and validated specifically for use with patients with IC to assess treatment effects on community walking ability. It quantifies the patient's walking capability in terms of defined distances and speeds, and rates the severity of claudication pain during usual walking activities. Results of the WIQ have proven valid and sensitive to change when correlated with changes in treadmill walking due to exercise intervention.

*Feasibility:* WIQ requires to be administered by an interviewer and takes approximately 6-8 minutes to complete. It can be awkward to complete due to American language used. Also, some patients cannot or do not do stairs and find this section difficult to answer.

(Appendix 1)

## **Quality of Life**

It is well documented in the literature that supervised exercise and home based exercise can improve quality of life and daily function. The specific questionnaires looking at this remain the same as the previous guidelines.

### **The Medical Outcomes Study Short Form 36 or SF36**

This is an overall measure of health status and functioning. It is not disease specific and measures many of the domains indicative of quality of life. It calculates separate scores from worst (0) to best (100) that represent eight discreet dimensions of health: physical functioning, physical role functioning, emotional role functioning, bodily pain, general health perception, vitality and fatigue, social functioning and mental health.

In response to the need for brevity in health status instrumentation an abbreviated version of the SF36 became available in 1996, known as the SF12. It has been proven valid, reliable and sensitive to change in numerous healthy and diseased populations including PAD.

*Feasibility:* SF36 can be interviewer or self administered and takes 5-7 minutes to complete.

(Appendix 2)

### **Charing Cross Questionnaire**

This is a condition specific instrument for assessment of health related quality of life in IC; lower scores indicating a better quality of life. It can be completed by the patient.

(Appendix 3)



## **Example of a Patient Journey with IC at NHS Highland**

Patients are referred by vascular consultants or specialist vascular nurse. When a patient is seen in the vascular clinic and referred into the program they will be given an information leaflet explaining the initial physiotherapy management. (Appendix 4)

### **First assessment**

Clinical history including

- Duration of symptoms
- Location of symptoms
- Aggravating and easing factors
- Worse on stairs/slopes
- How much walking is undertaken on a daily basis
- Night or rest symptoms
- Improving, worsening, static
- Smoking history
- Diabetic control
- Hypertension

The vascular nurse will measure the ankle/brachial pressure index pre and post treadmill test.

### **Treadmill test**

- This is our objective functional outcome measure
- Use a graduated incline programme– 1 min flat then 2 mins each at 3, 6, 9 and 12% gradients = total test time of 9 minutes.
- Speed to be set at patient's comfort

- Measure the pain onset distance (POD) and maximum walking distance (MWD) in metres. Also note the reason for the test stopping eg calf pain, SOB, tiredness etc.
- Try to encourage the patient to walk as far as they can in order to obtain a true claudication distance.

The treadmill test is then repeated after the set of classes or doing the HEP for 3/12 and distances compared.

Further treadmill follow up at 6months and 1 year post class.

Patients are educated about claudication and risk factors are addressed. Onward referral to smoking cessation is offered if appropriate. They are then shown the home exercises with advice to push a little further into their claudication pain before resting.

All patients are given the Home Exercise Programme (Appendix 5) and invited to attend the class (Appendix 6) if suitable. Heart rate measurements are taken before and after each supervised exercise class to monitor the patient's cardiovascular status.

## **Long Term Benefits**

Long term benefits from exercise therapy appear to be linked with the maintenance of increased activity at home. Patients should therefore be encouraged to exercise at home with the goal of changing their exercise habits in the long term. An advice booklet should be given to each patient and lectures or informal talks can be used in conjunction with the exercise classes to improve their knowledge on the benefits of exercise.

Long term follow-up and encouragement to exercise should be a consideration when planning exercise rehabilitation for these patients. Partnership with and referral on to community exercise schemes may be an option.

## **Research Implications**

There are many aspects of this subject which remain vague. Studies of a decent size specifically looking at the finer points of exercise prescription, duration and type are simply not available. Most of the studies are based on treadmill walking rather than circuit based exercises. With this in mind further research for the following areas is required

### **Exercise therapy**

- What degree of supervision is required?
- How long can a change in exercise habits last following completion of a supervised programme?
- Which programme (supervised or unsupervised) is the most effective in the long term (five years)?

- What level of compliance can be expected with exercise particularly in the long term and how can this be improved?
- What is the optimal exercise programme?
- Would community based exercise programmes help to maintain long term improvements in exercise habits?
- Is there an upper limit to walking performance after exercise?

### **Outcome measures**

- Which treadmill test is most reliable, valid and feasible?
- Is SF 8 valid, reliable and more feasible than SF 12 or SF36 with PAD population?
- What is the cost of supervised exercise sessions and how might this offset the cost of deterioration in terms of intervention needed.

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## APPENDIX 1

### **Modified (WIQ) Walking Impairment Questionnaire**

- Walking impairment: these questions ask about the reasons why you had difficulty walking. We would like to know how much difficulty you had walking because of each of these problems during the last week. By difficulty we mean how hard it was or how much physical effort it took to walk because of each of these problems.

	<b>Leg</b>	<b>Degree of Difficulty</b>					<b>Score</b>
	Right Left Both	None	Slight	Some	Much	Very	
<b>A. PAD Specific Questions</b>							
Pain, aching, or cramps in your calves or buttocks?		4	3	2	1	0	
% score = score/4 x 100							
<b>B. Differential Diagnosis</b>							
Pain, stiffness or aching in your joints (ankles, hips or knees)?		4	3	2	1	0	
Weakness in one or both of your legs?		4	3	2	1	0	
Pain or discomfort in your chest?		4	3	2	1	0	
Shortness of breath?		4	3	2	1	0	
Heart palpitations		4	3	2	1	0	
Other problems (please list)		4	3	2	1	0	

- Walking distance: Report the degree of physical difficulty that best describes how hard it was for you to walk on level ground without stopping to rest for each of the following distances during the last week.

	<b>Degree of Difficulty</b>					<b>Weight</b>	<b>Score</b>
<b>Distance</b>	None	Slight	Some	Much	Very	Feet	
Walking indoors, such as around your home?	4	3	2	1	0	X 20	
Walking 50 feet?	4	3	2	1	0	X 50	
Walking 150 feet (1/2 block)?	4	3	2	1	0	X 150	
Walking 300 feet (1 block)?	4	3	2	1	0	X 300	
Walking 600 feet (2 blocks)?	4	3	2	1	0	X 600	
Walking 900 feet (3 blocks)?	4	3	2	1	0	X 900	
Walking 1500 feet (5 blocks)?	4	3	2	1	0	X 1500	
% score = (sum of individual scores / 14080) x 100							

- Walking speed : Report the degree of physical difficulty that best describes how hard it was for you to walk during the last week, one city block on level ground at each of these speeds without stopping to rest.

	<b>Degree of Difficulty</b>					<b>Weight</b>	<b>Score</b>
<b>Speed</b>	None	Slight	Some	Much	Very	Mph	
Walking one block slowly?	4	3	2	1	0	X 1.5	
Walking one block at average speed?	4	3	2	1	0	X 2.0	
Walking one block quickly?	4	3	2	1	0	X 3.0	
Running or jogging 1 block?	4	3	2	1	0	X 5.0	
% score = (sum of individual scores / 46) x 100							

- Stair climbing: For each of these questions, report the degree of physical difficulty that best describes how hard it was for you to climb stairs without stopping to rest during the past week.

	<b>Degree of Difficulty</b>					<b>Weight</b>	<b>Score</b>
<b>Stairs</b>	None	Slight	Some	Much	Very	No. of stairs	

Climbing one flight of stairs?	4	3	2	1	0	X 12	
Climbing two flights of stairs?	4	3	2	1	0	X 24	
Climbing three flights of stairs?	4	3	2	1	0	X 36	
% score = (sum of individual scores / 288) x 100							

## APPENDIX 2

### CONFIDENTIAL WHEN COMPLETED

	<b>Quality of Life Questionnaire – SF36</b>
--	---

This survey asks for your views about your health. This information will help your Doctor to keep track of how you feel and how well you are able to do your usual activities. This will involve completing a questionnaire at various points of your treatment. Like all other aspects of your medical treatment the information obtained will be treated in **confidence**.

<b>Name:</b>	
<b>Date of Birth:</b>	
<b>Patient Number:</b>	
<b>Date:</b>	

Please answer every question by ticking (✓) the appropriate box. If you are unsure about how to answer a question, try and think about your overall health and give the best answer you can.

1	In general would you say your health is:	<b>Excellent</b> <input type="checkbox"/>	<b>Very Good</b> <input type="checkbox"/>	<b>Good</b> <input type="checkbox"/>
		<b>Fair</b> <input type="checkbox"/>	<b>Poor</b> <input type="checkbox"/>	

2	Compared to one year ago, how would you rate your health in general now?	<b>Much better</b> <input type="checkbox"/>	<b>A little better</b> <input type="checkbox"/>	<b>About the same</b> <input type="checkbox"/>
		<b>A little worse</b> <input type="checkbox"/>	<b>Much worse</b> <input type="checkbox"/>	

3	The following questions are about activities you might do during a typical day. Does your health now limit you in these activities? If so how much?			
		<b>Yes, limited a lot</b>	<b>Yes, limited a little</b>	<b>No, not limited at all</b>
a	<b>Vigorous Activities</b> i.e. running, lifting heavy objects, participating in strenuous sports.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
b	<b>Moderate Activities</b> i.e. moving a table, pushing a vacuum cleaner, bowling or playing golf.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
c	Lifting or carrying groceries	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
d	Climbing <b>several</b> flights of stairs	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
e	Climbing <b>one</b> flight of stairs	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
f	Bending, kneeling or stooping	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
g	Walking <b>more than a mile</b>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
h	Walking <b>half a mile</b>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
i	Walking <b>one hundred yards</b>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
j	Bathing and dressing yourself	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

4	During the <b>past four weeks</b> , have you had any of the following problems with your work or other daily activities <b>as a result of your physical health</b> ? Please answer <b>Yes</b> or <b>No</b> for each question.		
		<b>YES</b>	<b>NO</b>
a	Cut down on the <b>amount of time</b> you spent on work or other activities	<input type="checkbox"/>	<input type="checkbox"/>
b	<b>Accomplished less</b> than you would like	<input type="checkbox"/>	<input type="checkbox"/>
c	Were limited in the <b>kind</b> of work or other activities	<input type="checkbox"/>	<input type="checkbox"/>
d	Had <b>difficulty</b> performing the work or other activities (e.g. it took extra effort)	<input type="checkbox"/>	<input type="checkbox"/>

5	During the <b>past four weeks</b> , have you had any of the following problems with your work or other regular daily activities <b>as a result of any emotional problems</b> (such as feeling depressed or anxious)? Please answer <b>Yes</b> or <b>No</b> for each question.		
		<b>YES</b>	<b>NO</b>
a	Cut down on the <b>amount of time</b> you spent on work or other activities	<input type="checkbox"/>	<input type="checkbox"/>
b	<b>Accomplished less</b> than you would like	<input type="checkbox"/>	<input type="checkbox"/>
c	Didn't do work or other activities as <b>carefully</b> as usual	<input type="checkbox"/>	<input type="checkbox"/>

6	During the past 4 weeks, to what extent has your physical health or emotional problems interfered with your normal social activities with family, friends, neighbours or groups	Not at all <input type="checkbox"/> Slightly <input type="checkbox"/> Moderately <input type="checkbox"/>		
		Quite a bit <input type="checkbox"/> Extremely <input type="checkbox"/>		

7	How much bodily pain have you had during the past 4 weeks?	None <input type="checkbox"/>	Very Mild <input type="checkbox"/>	Mild <input type="checkbox"/>
		Moderate <input type="checkbox"/>	Severe <input type="checkbox"/>	Very Severe <input type="checkbox"/>

8	During the past 4 weeks, how much did pain interfere with your normal work (including both work outside the home and housework)	Not at all <input type="checkbox"/> A little bit <input type="checkbox"/> Moderately <input type="checkbox"/>		
		Quite a bit <input type="checkbox"/> Extremely <input type="checkbox"/>		

9	These questions are about how you feel and how things have been with you <b>during the past 4 weeks</b> . For each question please give the one answer that comes closest to the way you have been feeling.						
		All of the time	Most of the time	A good bit of the time	Some of the time	A little bit of the time	None of the time
a	Did you feel full of life?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>



b	Have you been a very nervous person?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
c	Have you felt so down in the dumps that nothing could cheer you up?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
d	Have you felt calm and peaceful?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
e	Did you have a lot of energy?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
f	Have you felt down-hearted and low?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
g	Did you feel worn out?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
h	Have you been a happy person?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
i	Did you feel tired?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

10	During the past 4 weeks, how much of the time has your physical health or emotional problems interfered with your social activities (like visiting your friends, relatives, etc.)?	All of the time <input type="checkbox"/> Most of the time <input type="checkbox"/> A good bit of the time <input type="checkbox"/>					
		Some of the time <input type="checkbox"/> A little of the time <input type="checkbox"/> None of the time <input type="checkbox"/>					

11	How <b>TRUE</b> or <b>FALSE</b> is each of the following statements for you?					
		<b>Definitely True</b>	<b>Mostly True</b>	<b>Don't Know</b>	<b>Mostly False</b>	<b>Definitely False</b>
a	I seem to get ill more easily than other people	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
b	I am as healthy as anybody I know	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
c	I expect my health to get worse	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
d	My health is excellent	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

**Thank you for your time and co-operation**

## APPENDIX 3

### **Modified Intermittent Claudication Charing Cross Questionnaire** (with scoring which is out of 80)

Name:

Date:

The questions below ask about the problems of pains, cramps, numbness or discomfort that patients with arterial disease get in their calves, thighs or buttocks when walking. The term “leg pains” has been used to describe all of these problems. If you are unsure about how to answer the question please give the best answer you can. Tick only one box per question.

1. During the **past 2 weeks**, how severe were your leg pains?

<b>None, I had Very no severe</b>	<b>Very mild</b>	<b>Mild leg</b>	<b>Moderate</b>	<b>Severe pain</b>
<b>0</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

The following questions ask about the activities you might do during a typical day. Do your leg pains limit you in these activities? If so, how much?

	<b>Totally limited</b>	<b>Very limited</b>	<b>Moderately limited</b>	<b>A little limited</b>	<b>Not limited</b>
<b>at all</b>					
2. Crossing the road	<b>5</b> <input type="checkbox"/>	<b>3.75</b> <input type="checkbox"/>	<b>2.5</b> <input type="checkbox"/>	<b>1.25</b> <input type="checkbox"/>	<b>0</b> <input type="checkbox"/>
3. Using the bus/train	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. Climbing one flight of stairs	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Not limited</b>	<b>Totally limited</b>	<b>Very limited</b>	<b>Moderately limited</b>	<b>A little limited</b>	
<b>at all</b>					
	<b>5</b>	<b>3.75</b>	<b>2.5</b>	<b>1.25</b>	<b>0</b>

5. Climbing ☐ ☐ ☐ ☐ ☐  
several flights of stairs
6. Walking ☐ ☐ ☐ ☐ ☐  
more than a mile
7. Walking ☐ ☐ ☐ ☐ ☐  
☐ more than 100 yards

	<b>Totally limited</b>	<b>Very limited</b>	<b>Moderately limited</b>	<b>A little limited</b>	<b>Not limited at all</b>
--	------------------------	---------------------	---------------------------	-------------------------	---------------------------

- |                           |                          |                          |                          |                          |                          |
|---------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
|                           | <b>5</b>                 | <b>3.75</b>              | <b>2.5</b>               | <b>1.25</b>              | <b>0</b>                 |
| 8. Going out of the house | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

9. During the **past 2 weeks**, how often have you had to stop walking and rest because of the pains in your leg?

<b>More than 3 times a day</b>	<b>2 to 3 times a day</b>	<b>Once a day</b>	<b>Less than once a week</b>	<b>Not at all</b>
<b>5</b>	<b>3.75</b>	<b>2.5</b>	<b>1.25</b>	<b>0</b>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

10. During the **past 2 weeks**, how much time have you spent thinking about your leg pains?

<b>All of the time</b>	<b>Most of the time</b>	<b>Some of the time</b>	<b>A little of the time</b>	<b>None of the time</b>
<b>5</b>	<b>3.75</b>	<b>2.5</b>	<b>1.25</b>	<b>0</b>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

11. During the **past 2 weeks**, how much of the time have you felt downhearted and low because of the pains in your leg?

<b>All of the time</b>	<b>Most of the time</b>	<b>Some of the time</b>	<b>A little of the time</b>	<b>None of the time</b>
<b>5</b>	<b>3.75</b>	<b>2.5</b>	<b>1.25</b>	<b>0</b>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

12. During the **past 2 weeks**, how much of the time have you been worried that your leg pains will get worse?

<b>All of</b>	<b>Most of</b>	<b>Some of</b>	<b>A little of</b>	<b>None of</b>
---------------	----------------	----------------	--------------------	----------------

the time	the time	the time	the time	the time
5	3.75	2.5	1.25	0
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

13. During the **past 2 weeks**, how much did your leg pains interfere with your normal work (including work both outside the home and housework)

Not at all Extremely	A little bit	Moderately	Quite a bit
0	1.25	2.5	3.75
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

14. During the **past 2 weeks**, how much of the time have your leg pains interfered with your hobbies or pastimes?

Not at all Extremely	A little bit	Moderately	Quite a bit
0	1.25	2.5	3.75
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

15. During the **past 2 weeks**, how much did your leg pains interfere with your social activities (like visiting with friends, relatives etc.)

All of of the time time	Most of the time	Some of the time	A little of the time	None the
5	3.75	2.5	1.25	0
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

16. During the **past 2 weeks**, how much of the time have your leg pains interfered with doing errands (like shopping, going to the post office or bank etc?)

All of of the time time	Most of the time	Some of the time	A little of the time	None the
5	3.75	2.5	1.25	0
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

## Appendix 4



# PHYSIOTHERAPY FOR INTERMITTENT CLAUDICATION

Intermittent claudication is a symptom of vascular disease where there is not enough blood reaching exercising muscles. This can cause a range of symptoms including pain, tightness, tiredness and cramps.

To increase the circulation and reduce these symptoms it is important to try to exercise/walk through your pain a little before resting and then carrying on again. Exercise therapy is the ideal initial management for this condition.

There are 3 parts to the Raigmore exercise therapy programme

- 1) Initial assessment – you will be assessed by a physiotherapist regarding symptoms, current exercise/walking ability and risk factors. The vascular nurse will measure the blood pressure in your legs and you will then undergo a treadmill walking test (or alternative if you cannot manage the treadmill). On the treadmill we measure the distance your pain starts at and then the maximum distance you can manage.
- 2) Home Exercise Programme (HEP) - this comprises 3 basic exercises to do in your home and also focuses on the motivation and encouragement to walk more
- 3) Gym Exercise Programme – to accompany the HEP there is also a gym exercise class held in the physiotherapy department every Wednesday. This class lasts for 1 hour and runs for 12 weeks (may take longer if you have holidays etc)

It has been found that claudication symptoms are more likely to improve when doing both parts of the exercise programme but sometimes work commitments or where you live may prevent you attending the class.

On finishing the 12 week initial exercise programme you will be re-tested on the treadmill to compare your walking distances with the initial assessment. This will be reported back to your referring vascular consultant who may then review you in the vascular clinic. If you still have symptoms which interfere with your quality of life you may be referred for a scan of your arteries with a view to some form of surgical intervention.

Mairi Ross  
Vascular Physiotherapist  
Raigmore Hospital  
May 2018

## APPENDIX 5

# HOME EXERCISE PROGRAMME

FOR THIS PROGRAMME TO SUCCEED IT MUST  
BE STRICTLY ADHERED TO

## EXERCISES TO BE PERFORMED ONCE A DAY

THE 3 EXERCISES BELOW HAVE TO BE DONE FOR 5 MINUTES EACH

### **1. SITTING WITH LEGS SUPPORTED**

PUMP ANKLES UP AND DOWN

### **2. SITTING IN HARD CHAIR**

SLOWLY STAND AND SIT

### **3. STANDING**

LIFT UP AND DOWN ON TIPTOES (MINIMAL SUPPORT)

### **4. WALKING**

AS FAR AS POSSIBLE 1 OR 2 TIMES A DAY

In total this exercise programme should take approximately 15 minutes but you may find it takes a little longer due to rest stops.

Remember - for the programme to work, you must exercise up to **AND PAST** the point of pain where you would normally stop.

If you have any problems with the above exercises please contact Mairi Ross (vascular physiotherapist) 01463 704000 bleep 2003

## APPENDIX 6

### GYM PROGRAMME

Name \_\_\_\_\_

DATE																				
PULSE																				
SQUATS																				
DUMB-BELLS																				
*																				
WALK																				
STEPPER MACHINE																				
HEEL DIPS																				
PRESS-UPS AGAINST WALL BARS																				
STEP UPS																				
X - TRAINER / TREADMILL																				