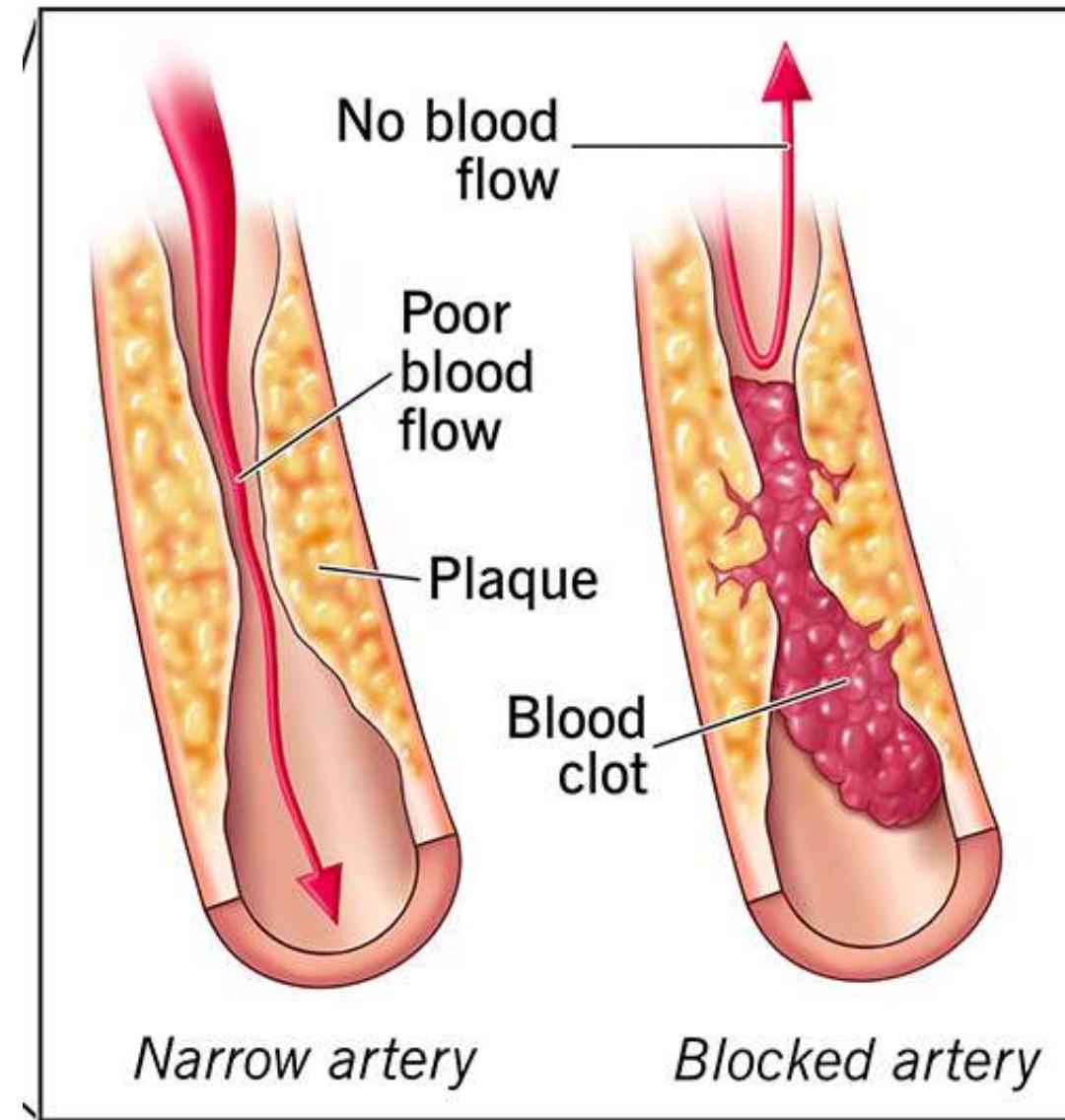


Alternatives to Surgery for Peripheral Arterial Disease

Philip Stather

Peripheral Arterial Disease

- 20% over over 60's
- Mostly asymptomatic
- Male
- Smoking
- Diabetes
- Hypertension

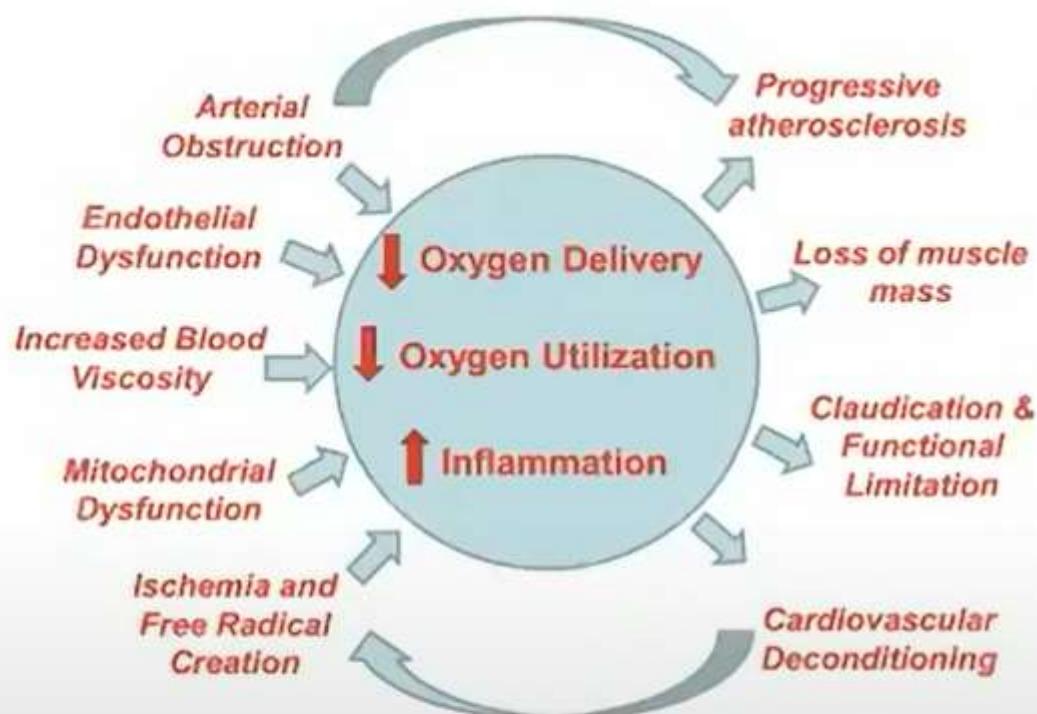


Presentation

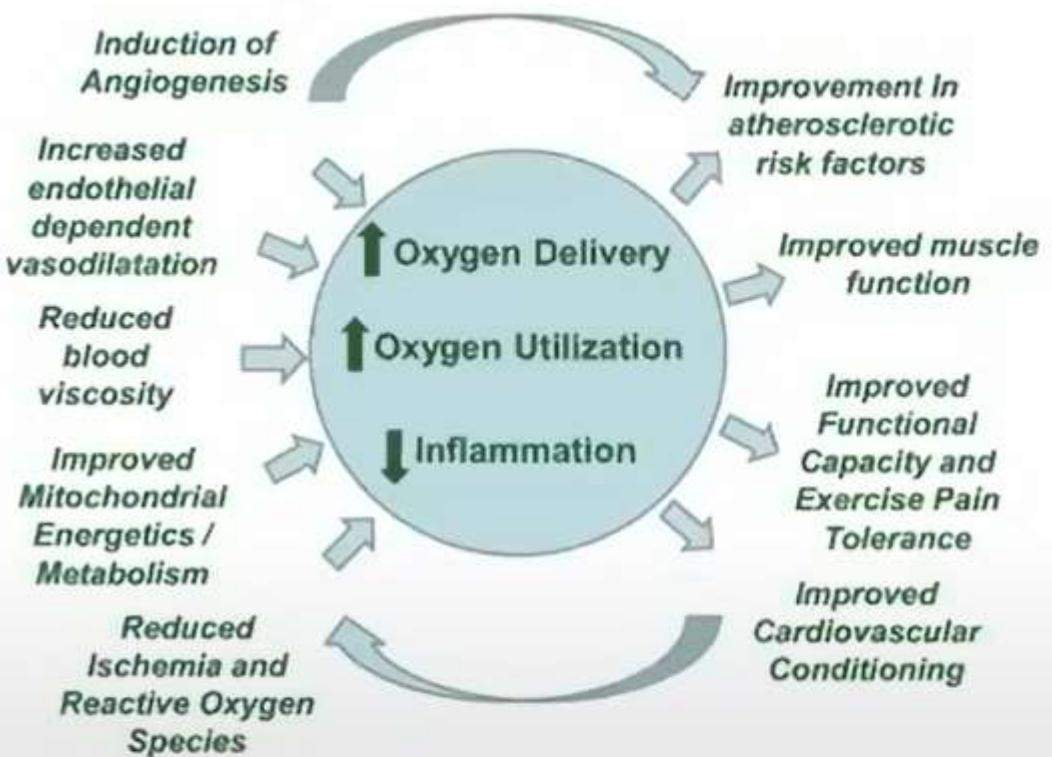
Walk
A
Cise

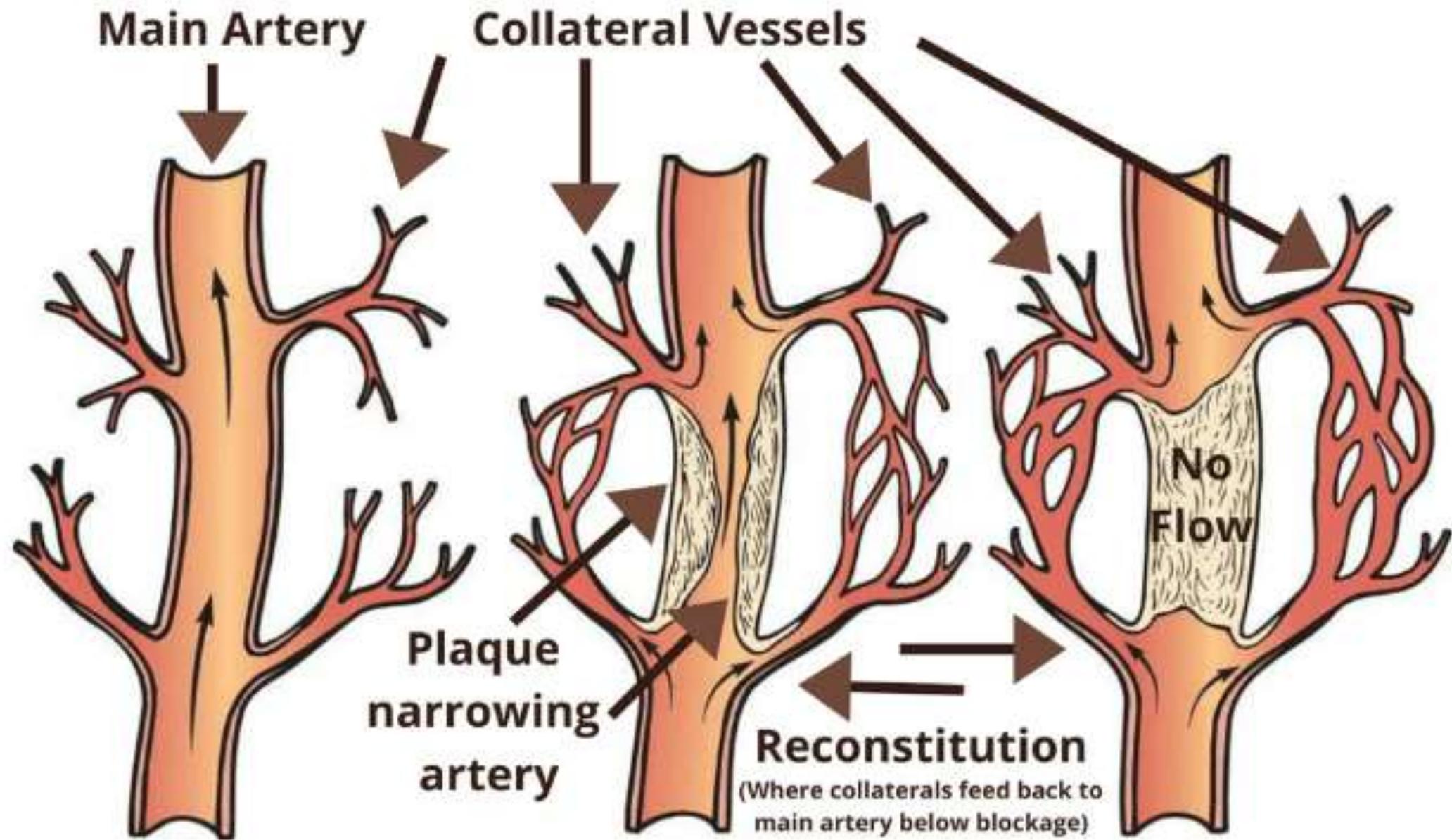


Mechanisms of Functional Impairment in Peripheral Artery Disease

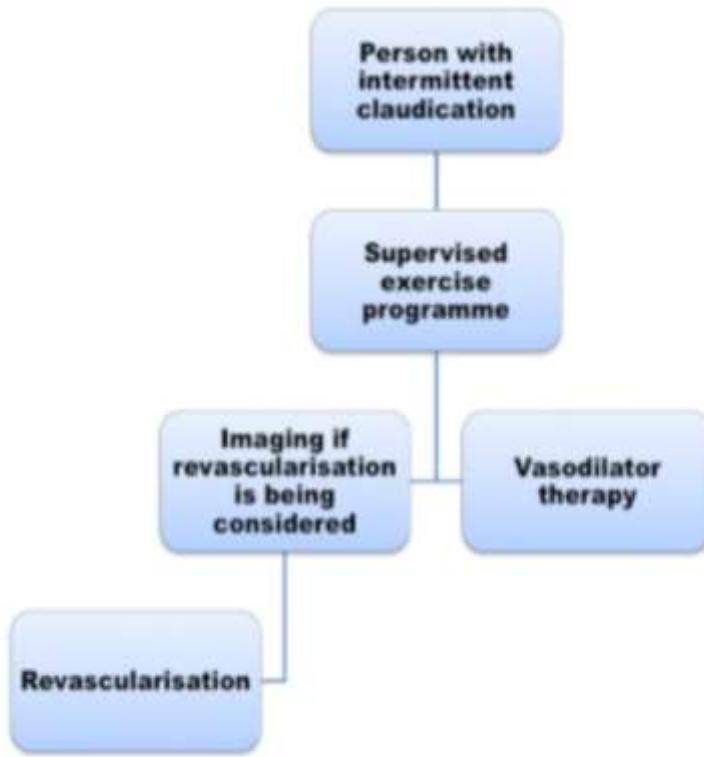


Potential Mechanisms of Benefit of Exercise in Peripheral Artery Disease





Funding from the NHS



Editorial > *Eur J Vasc Endovasc Surg.* 2014 Dec;48(6):608-10. doi: 10.1016/j.ejvs.2014.07.008.
Epub 2014 Aug 28.

Why do health systems not fund supervised exercise programmes for intermittent claudication?

M A Popplewell ¹, A W Bradbury ²

Access to supervised exercise services in the UK NHS for patients with peripheral vascular disease

Article (PDF Available) in *Annals of The Royal College of Surgeons of England* · July 2016 with 287 Reads ①

[Article \(PDF Available\)](#) in *Annals of The Royal College of Surgeons of England* · July 2016 with 287 Reads ①

[Cite this publication](#)

38% have access to supervised exercise classes!

Figure 1 NICE PAD Pathway: management of intermittent

Supervised v Unsupervised Exercise Programmes

Cochrane Database Syst Rev, 2013 Aug 23;(8):CD005263. doi: 10.1002/14651858.CD005263.pub3.

Supervised exercise therapy versus non-supervised exercise therapy for intermittent claudication.

Fokkenrood HJ¹, Bendermacher BL, Lauret GJ, Willigendael EM, Prins MH, Teijink JA.

Supervised Exercise Therapy confers a significant improvement in walking distance compared to non-supervised regimes, size effect 0.48, or twice as good)

Cochrane Database Syst Rev, 2014 Jul 18;(7):CD000990. doi: 10.1002/14651858.CD000990.pub3.

Exercise for intermittent claudication.

Lane R¹, Ellis B, Watson L, Leng GC.

Supervised Exercise Therapy confers a significant improvement in walking distance by 50-200% compared to placebo

Recommendations for Exercise Therapy for PAD

Referenced studies that support the recommendations are summarized in the [Online Data Supplement](#).

COR	LOE	Recommendations
1	A	1. In patients with chronic symptomatic PAD, SET is recommended to improve walking performance, functional status, and QOL. ^{7,16-28}
1	A	2. In patients with chronic symptomatic PAD, a structured community-based exercise program with behavioral change techniques is effective to improve walking performance, functional status, and QOL. ⁵⁻¹⁵
1	A	3. In patients who have undergone revascularization for chronic symptomatic PAD, SET after revascularization is effective to improve walking performance, functional status, and QOL. ²⁹⁻³⁹
1	B-R	4. In patients with functionally limiting claudication, SET or a structured community-based exercise program should be offered as an initial treatment option. ^{17,18,25,40}
2a	A	5. In patients with chronic symptomatic PAD, alternative programs of nonwalking structured exercise therapy (eg, arm ergometry, recumbent stepping) can be beneficial to improve walking performance, functional status, and QOL. ^{19,20,41-47}
2b	B-R	6. In patients with chronic symptomatic PAD, the usefulness of structured walking exercise therapy that avoids moderate to severe ischemic symptoms is uncertain. ^{5,45,46}
2b	B-R	7. In patients with chronic symptomatic PAD, the usefulness of unstructured exercise to improve walking performance, functional status, and QOL is uncertain. ^{10,12,28}

SET good for PAD

Home based is Ok

Good after surgery

Should be initial treatment option

Alternative therapies may be Ok

Unstructured programmes are uncertain

SET recommendations

Supervised Exercise Therapy^{5,7,16-28,42,52,53}

Primarily focuses on intermittent walking exercise on a treadmill, interspersed with rest periods when pain becomes moderate or severe.

Program takes place in a hospital or outpatient facility and is often placed within a cardiac rehabilitation program setting; can be standalone if necessary.

Program is directly supervised by qualified health care professional(s); generally clinical exercise physiologists or nurses with exercise training experience.

Training is performed for a minimum of 30-45 min per 60-min session. Supervised sessions are performed at least 3 times/wk for a minimum of 12 wk.

Training involves intermittent bouts of walking to moderate-to-maximum claudication pain or discomfort, alternating with periods of rest, with incremental increases as function and symptoms improve. Goal is to progress to 30-45 min of active walking exercise during each session.

Nontreadmill modalities (eg, stationary bicycle) can be used when appropriate and continually assessed to determine when or if the patient can use a treadmill.

Supervised exercise therapy is a covered benefit by Medicare and most commercial insurances.

Home based recommendations

Structured Community-Based Exercise Program^{5,6,8,9,12,15,19,57,63-66}

Program takes place in the personal setting (eg, home, community, neighborhood) of the patient rather than in a clinical setting.

Qualified health care professional(s) prescribe an exercise regimen similar to that of a supervised program.

Program is self-directed with the guidance of qualified health care professional(s) and is generally walking-based.

Patient counseling ensures understanding of how to begin and maintain the program and how to progress the difficulty of the walking (by increasing distance or speed).

Program may incorporate behavioral change techniques, delivered by in-person or virtual health coaching or the use of activity monitors.

Program may include periodic supervised exercise sessions to assess progress, reinforce adherence, and make exercise prescription alterations when appropriate.

- Not all SET classes comply with NICE recommendations
- Unable to provide more than once per week
- Unable to provide 12 classes per patient



Supervised Exercise v Angioplasty

Long-term clinical effectiveness of supervised exercise therapy *versus* endovascular revascularization for intermittent claudication from a randomized clinical trial

F. Fakhry, E. V. Rouwet, P. T. den Hoed, M. G. M. Hunink, S. Spronk

First published: 10 July 2013 Full publication history

Supervised Exercise, Stent Revascularization, or Medical Therapy for Claudication Due to Aortoiliac Peripheral Artery Disease: A Randomized Clinical Trial

Timothy P. Murphy, MD,¹ Donald E. Cutlip, MD,^{1,2} Judith G. Regensteiner, PhD,³ Emile R. Mohler, MD, MSc,⁴ Matthew R. Reynolds, MD,⁵ Joseph M. Massaro, PhD,^{6,7} Beth A. Levy, MD,⁸ Niki C. Oldenburg, DrPH,¹¹ Claudia C. Thum, MA,⁹ Michael R. Jaff, DO,¹² Anthony A. Bavry, MD,¹³ Michael W. Steffes, MD,¹⁴ Ingrid H. Abrahamsen, MS,¹⁵ Suzanne Goldberg, MSN,¹⁶ and



JACC: Cardiovasc

Volume 10, Issue 7

July 2013 712-724



Peripheral
Comparing the Efficacy of Endovascular
Revascularization Versus Supervised
Exercise Training in Patients With
Intermittent Claudication: Meta-Analysis
of Randomized Controlled Trials

Ambarish Pandey MD ^a, Subhash Banerjee MD ^a, Christian Ngo MD ^a, Purav Mody MD ^a, Steven P. Marso MD ^a, Emmanouil S. Brilakis MD, PhD ^a, Ehrin J. Armstrong MD, MS ^b, Jay Giri MD, MPH ^c, Marc P. Bonaca MD, MPH ^d, Aruna Pradhan MD, MPH ^d, Anthony A. Bavry MD, MPH ^e, Dharam J. Kumbhani MD, SM ^{a, f, g}

Systematic review

Systematic review of exercise training or percutaneous transluminal angioplasty for intermittent claudication

F. A. Frans , S. Bipat, J. A. Reekers, D. A. Legemate, M. J. W. Koelemay

First published: 16 September 2011 Full publication history

LONG TERM NO DIFFERENCE BETWEEN SUPERVISED EXERCISE AND ANGIOPLASTY

NICE

Table 1. NICE CG 147 recommendations regarding IC.¹

- 1.5.1 Offer a supervised exercise programme (SEP) to all people with intermittent claudication (IC).
- 1.5.2 Consider providing a SEP for people with IC which involves: 2 hours of supervised exercise a week for a 3-month period and encourages people to exercise to the point of maximal pain.
- 1.5.3 Offer angioplasty for treating people with SEP only when: advice on the benefits of modifying risk factors has been reinforced (see recommendation 1.2.1) and a SEP has not led to a satisfactory improvement in symptoms and imaging has confirmed that angioplasty is suitable for the person.

NICE Guideline but not funded in most hospitals!

What Else Can We Do? Heat Therapy

Study or Subgroup		6 minute walk test	Intervention Details
Akerman (2019)	Monroe 2020		
Total (95%)			
Heterogen			
Test for o			
Study or Subgroup	Intervention Details		
Akerman (2019)	Supervised hot immersion (3-5/week 39°C)		
Monroe (2020)	Water circulating trousers (90 mins, 3/wk, 47-50°C)		
Monroe (2021)	Water circulating trousers (90 mins, 3/wk, 43°C)		
Shinsato (2010)	Woan dry sauna (15 mins, 5/wk, 60°C)		
Study or Subgroup	Intervention Details		
Akerman (2019)	Woan dry sauna (15 mins, 5/wk, 60°C)		
Shinsato (2010)	Continuous short wave diathermy (20 mins, mod heat)		
Total (95%)			
Heterogen			
Test for o			
Pellinger (2019)	Acute – Lower limb heated immersions (15 min v 45 min).		
Neff (2016)	Acute – Lower body water perfused suit (90 min, 48°C)		
Thomas (2021)	Acute – Waist level immersion (30 min, 42°C)		

What Else Can We Do? NMES



What Else Can We Do? NMES

Randomized Controlled Trial > Br J Surg. 2023 Nov 9;110(12):1785-1792.

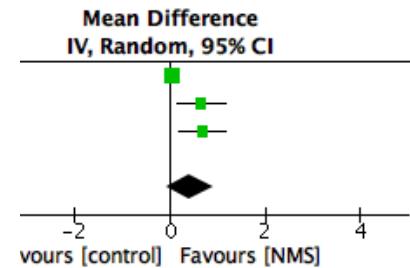
doi: 10.1093/bjs/znad299.

Neuromuscular Electrical Stimulation for Intermittent Claudication (NESIC): multicentre, randomized controlled trial

Laura Burgess ^{1 2}, Adarsh Babber ^{1 2}, Joseph Shalhoub ^{1 2}, Sasha Smith ^{1 2},
Consuelo N de la Rosa ³, Francesca Fiorentino ^{1 3 4}, Bruce Braithwaite ⁵, Ian C Chetter ⁶,
James Coulston ⁷, Manjit S Gohel ⁸, Robert Hinchliffe ⁹, Gerard Stansby ¹⁰, Alun H Davies ^{1 2},
NESIC Trial Investigators

functional and quality-of-life parameters in peripheral artery disease: pilot clinical trial

Effect of non-invasive neuromuscular electrical stimulation on functional and quality-of-life parameters in peripheral artery disease: pilot clinical trial



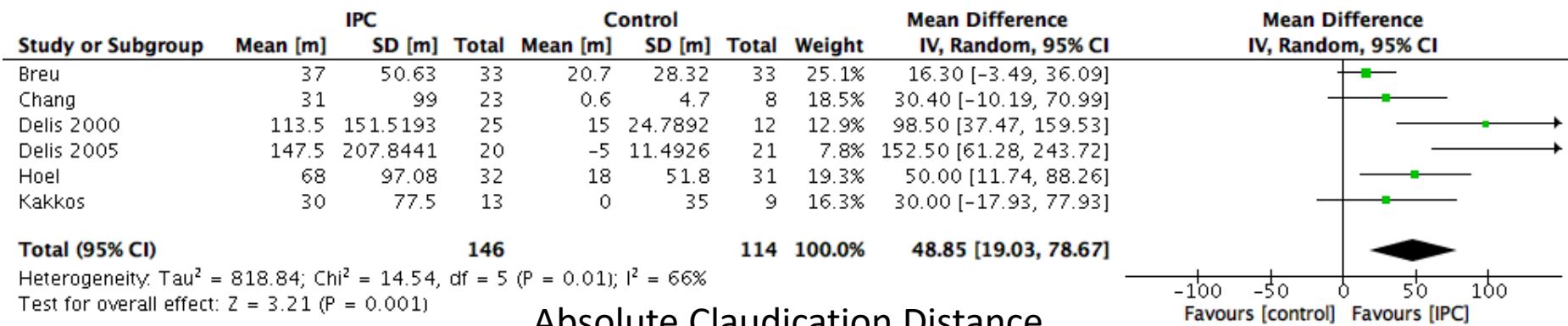
Improved initial
claudication distance
= 40.4 v 7.5m

What Else Can We Do? IPC

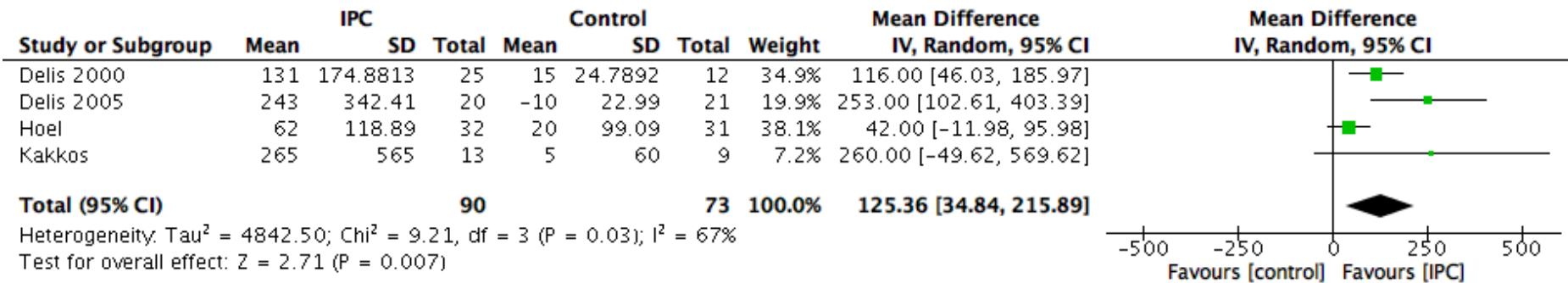


What Else Can We Do? IPC

Initial Claudication Distance



Absolute Claudication Distance



Ultrasound Therapy

Am J Surg. 2021 June ; 221(6): 1271–1275. doi:10.1016/j.amjsurg.2021.02.017.

Ultrasound therapy for treatment of lower extremity intermittent claudication

Gregory J. Landry, MD, David Louie, BS, David Giraud, MD, Azzdine Y Ammi, PhD, Sanjiv Kaul, MD

Knight Cardiovascular Institute Oregon Health & Science University

Ultrasound Therapy

10 Subjects

Water interface between US and legs

Pulsed US therapy at 250kHz

30 mins 3x per week for 6 weeks

Increased 6MWT from 353-372m

ABPI 0.53-0.64

WIQ 2.00-2.63

Improvement in SF36

Shockwave Lithotripsy

- Acoustic shockwaves
- Catheter inserted to deliver angioplasty balloon with ultrasound element to affected artery
- Helps to crack the calcium within the arterial wall

The Future

- High Frequency Ultrasound

► *BMJ Open*. 2022 May 2;12(5):e058418. doi: [10.1136/bmjopen-2021-058418](https://doi.org/10.1136/bmjopen-2021-058418)

► *Int J Hyperthermia*. 2020;37(1):903-912. doi: 10.1080/02656736.2020.1795278.

Safety and feasibility of arterial wall targeting with robot-assisted high intensity focused ultrasound: a preclinical study

M H A Groen ¹, F J B Slieker ², A Vink ³, G J de Borst ², M V Simons ², E S Ebbini ⁴,
P A Doevedans ^{1 5 6}, C E V B Hazenberg ², R van Es ¹

Safety and feasibility study of non-invasive robot-assisted high-intensity focused ultrasound therapy for the treatment of atherosclerotic plaques in the femoral artery: protocol for a pilot study

Michelle V Simons ^{1,✉}, Marijn H A Groen ², Gert J de Borst ³, Tim Leiner ⁴, Pieter A F Doevedans ^{2,5}, Emad Ebbini ⁶, Fons J B Slieker ⁷, René van Es ², Constantijn E V B Hazenberg ³

►  Editorial ► *Curr Med Res Opin*. 2020 Mar;36(3):509-512. doi: 10.1080/03007995.2019.1699518.

Epub 2019 Dec 6.

High intensity focused ultrasound (HIFU) for the treatment of varicose veins and venous leg ulcers – a new non-invasive procedure and a potentially disruptive technology

Mark S Whiteley ¹

Affiliations 

ABSTRACT

Originally Published 25 November 2014 | 



Abstract 12973: High-Intensity Focused Ultrasound (HIFU) Promotes Angiogenesis in a Rat Model of Peripheral Arterial Disease

Babak Nazer, Farzin Ghahghaei, Tatiana Kokhlova, Camilo Perez, Lawrence Crum, Thomas Matula, and Akiko Hata | [AUTHOR INFO & AFFILIATIONS](#)

Walk-A-Cise

Supervised exercise

Not Available

Unsupervised exercise

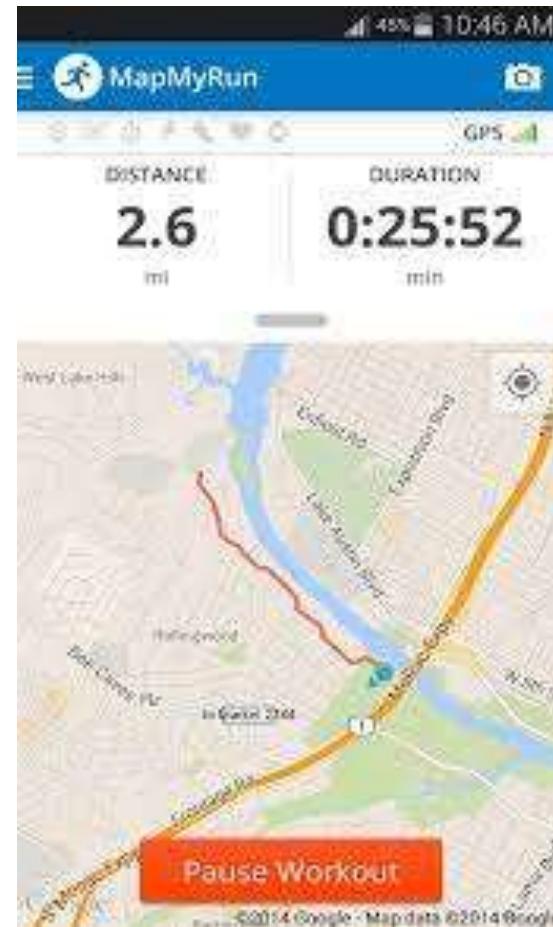
Not Effective

Alternative Therapies

Not Funded

Virtual Supervised Exercise

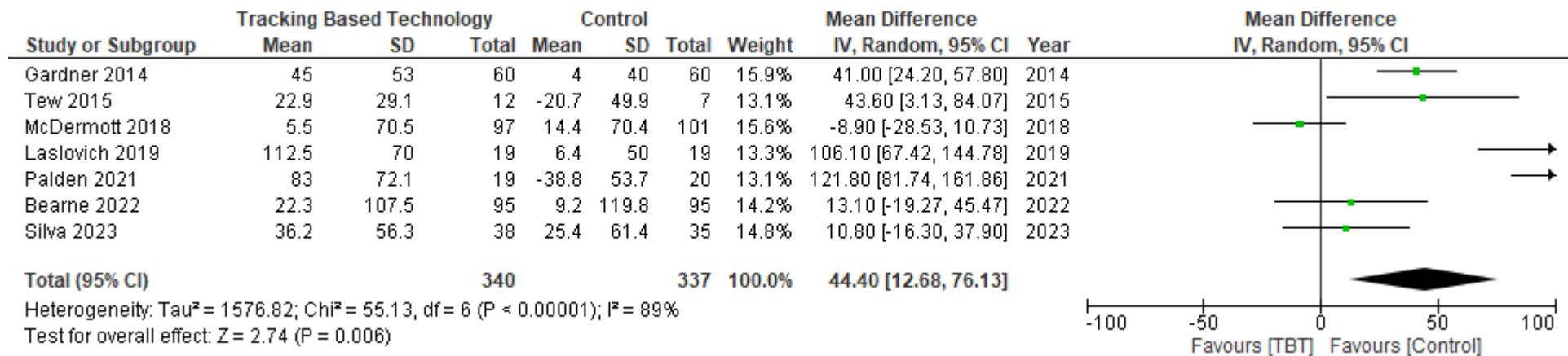
Walk
A
Cise



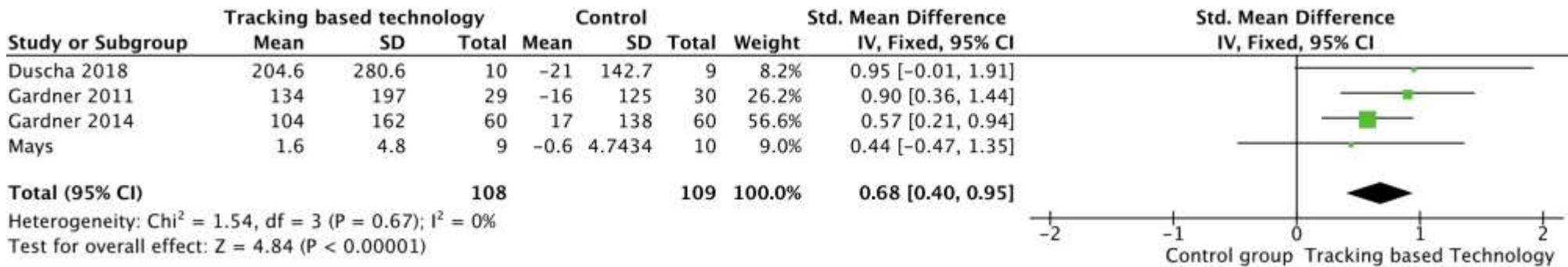
fitbit

Apps and SmartWatches

6 minute walk test

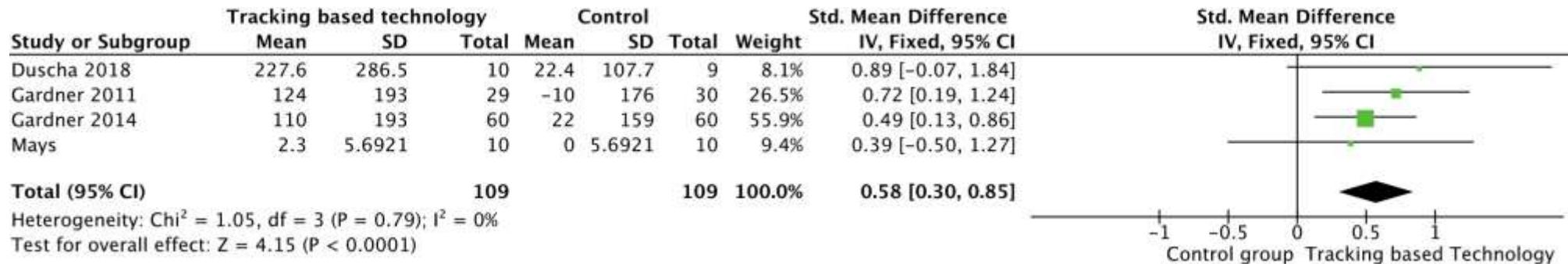


Claudication onset time

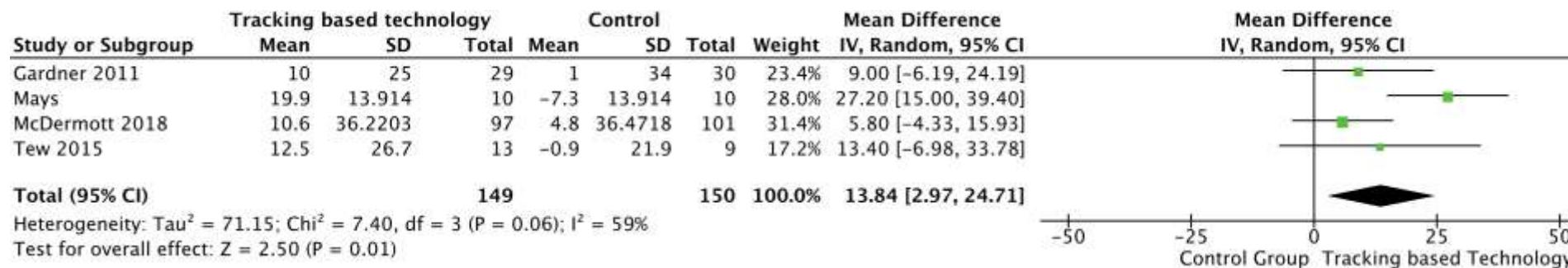


Apps and SmartWatches

Peak walking time

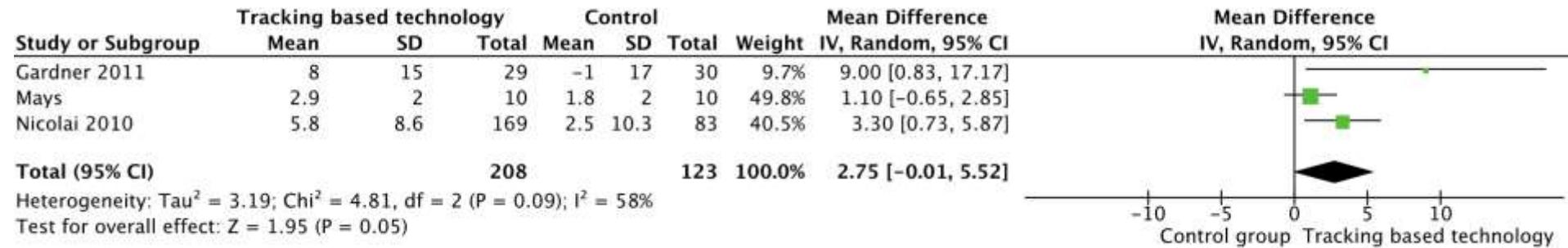


Walking impairment questionnaire



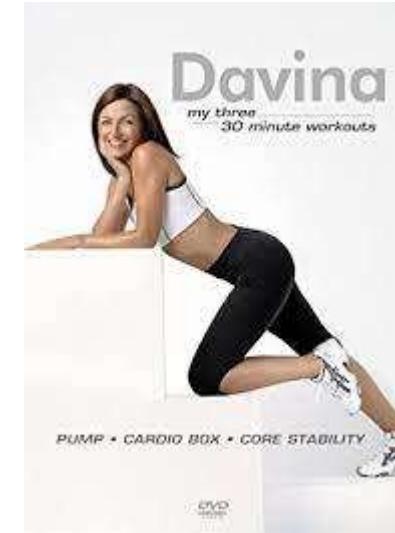
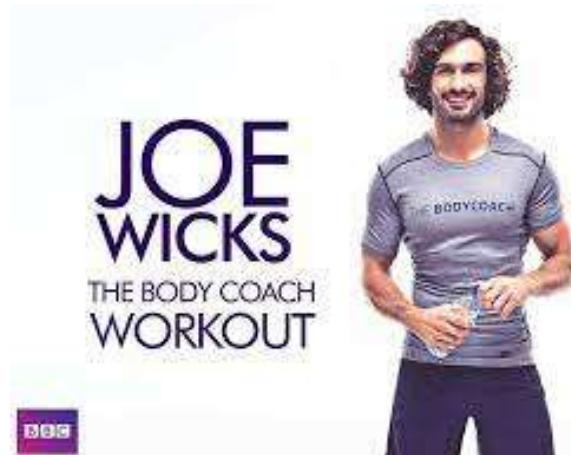
Apps and SmartWatches

Quality of Life



What we have made

- Clinician Dashboard designed with HCPs
- Mobile phone application designed with patients



BOWER, Andy X

BOWER, Andy

+ Add Patient Search patients

Message Patient Add To

[Episode](#) [Demographics](#) [Multimedia](#) [Documents](#) [Questionnaire](#)

EPISODE INFORMATION

Hospital
Norwich

Clinician
Stather

Current, Ex, Never
Ex

Active, Inactive last 7 days, Cancelled
Active

Stroke, MI, DMI, IHD, CCF, COPD
DMI

Bypass, angioplasty, which side
angioplasty

Antiplatelet, statin, anticoag, B-blocker, ACEI
Antiplatelet

CHART

Distance
Initial Claudication Distance

Date	Initial Claudication Distance
20/06/2023	~200
17/06/2023	~100
15/06/2023	~100
11/06/2023	0
10/06/2023	~200
09/06/2023	~100
08/06/2023	~800
07/06/2023	~500
04/06/2023	~300

BOWER, Andy X

BOWER, Andy 23/11/1975 Gender: Male Age: 47 Email: andy@andybower1.plus.com Phone Number: +44 7712 526598

[+ Add Patient](#) [Search patients](#)

[Message Patient](#) [Add To](#)

[Episode](#) [Demographics](#) [Multimedia](#) [Documents](#) [Questionnaire](#)

EPISODE INFORMATION

Hospital
Norwich

Hospital
NNUH

Active, Inactive last 7 days, Cancelled
Active

Stroke, MI, DMI, IHD, CCF, COPD
DMI

Bypass, angioplasty, which side
angioplasty

Antiplatelet, statin, anticoag, B-blocker, ACEI
Antiplatelet

Clinician
Stather

Current, Ex, Never
Ex

CHART

Distance

Initial Claudication Distance

Total Waking Distance

Max Waking Distance

Initial Claudication Distance

Six Minute Walk Test

Date	Initial Claudication Distance
20/06/2023	~300
22/06/2023	~250
24/06/2023	~250
26/06/2023	~250
28/06/2023	~250
30/06/2023	~250
01/07/2023	~250
03/07/2023	~250
05/07/2023	~250
07/07/2023	~250
08/07/2023	~800
10/07/2023	~250
12/07/2023	~250
14/07/2023	~250
16/07/2023	~250
18/07/2023	~250
20/07/2023	~250
22/07/2023	~250
24/07/2023	~250
26/07/2023	~250
28/07/2023	~250
30/07/2023	~250
01/08/2023	~250
03/08/2023	~250
05/08/2023	~250
07/08/2023	~250
09/08/2023	~250
11/08/2023	~250
13/08/2023	~250
15/08/2023	~250
17/08/2023	~250
19/08/2023	~250
21/08/2023	~250
23/08/2023	~250
25/08/2023	~250
27/08/2023	~250
29/08/2023	~250
31/08/2023	~250
02/09/2023	~250
04/09/2023	~250

BOWER, Andy X

+ Add Patient Search patients

BOWER, Andy 23/11/1975 Gender Male Age 47 Email andy@andybower1.plus.com Phone Number +44 7712 526598

Message Patient Add To

Episode Demographics Multimedia Documents Questionnaire

WALKING DATA

	Date	Distance (meters)	Speed(m/s)
First Walk	22/04/2023	2431	1.07
Last Walk	20/06/2023	987	0.42
First 6 MWT	16/05/2023	506	1.41

ALTERNATE ACTIVITIES

	Date	No Of Times Last Month
		No activity found yet

INTERVENTION DATA

	Procedure Code	Side	Date
Surgical Intervention	Operation Code	Left	01/02/2023
Endovascular Intervention	Operation Code	Right	05/02/2023
Surgical Intervention	Operation Code	Left	01/02/2023
Endovascular Intervention	Operation Code	Right	05/02/2023

EXERCISE VIDEOS

	Date first Watch	Date Last Watch	Total Number Views
Video1.mp4	24/04/2023	24/04/2023	1

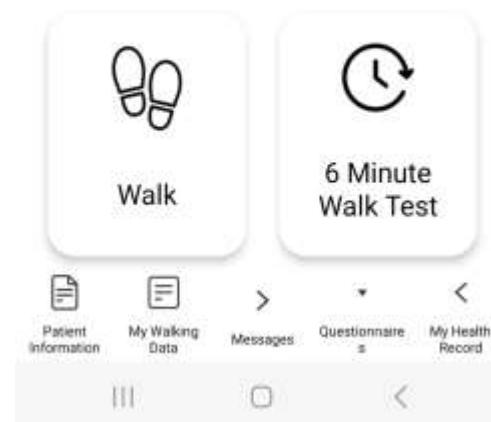
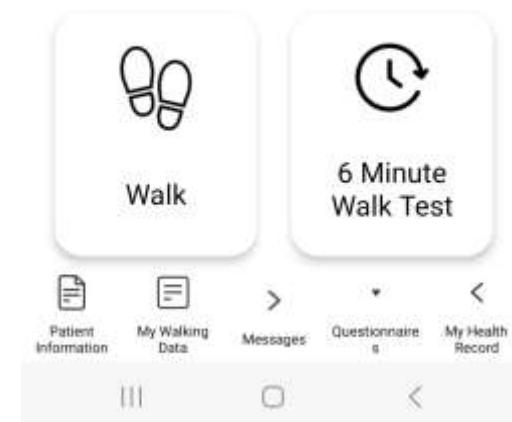
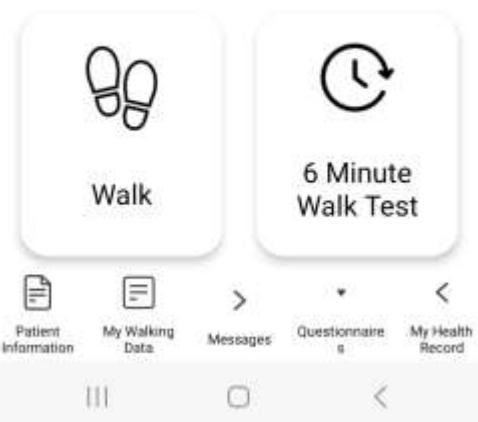
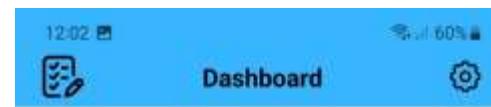
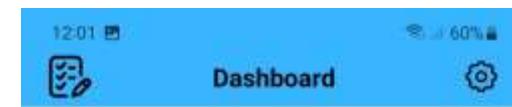
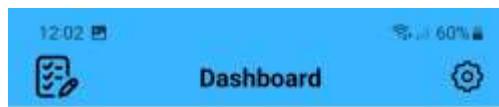
Walk
A
Cise



Walk
A
Cise

Powered by Granite





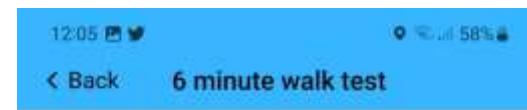
Walk A Cise



Time 1:03

Distance 61 meter

Speed 0.97 m/s



Last Test Distance

506 meter

05 47

MM SS



Distance Walked

17 meter

12:07 58%

Back Patient Information

→ Introduction.docx

→ Walking.docx

→ SixMinuteWalkTest.docx

→ ReviewWalks.docx

→ OtherActivities.docx

→ TermsAndConditions.docx

→ WithdrawalOfConsent.docx

→ PatientAndPublicInvolvement.docx

→ TroubleShooting.docx

||| □ <



1. Mobility

I have no problems in walking about

I have slight problems in walking about

I have moderate problems in walking about

I have severe problems in walking about

I am unable to walk about

2. Self-Care

I have no problems washing or dressing myself

I have slight problems washing or dressing myself

I have moderate problems washing or dressing myself

I have severe problems washing or dressing myself

I am unable to wash or dress myself

[Edit Answer](#)



Animations – 30 minute classes

Walk
A
Cise

Warm Ups
Marching
on the spot



Step Up



Wall Press
Next up:
Sit to
Stand



Levels
1.Higher hands



2.Lower hands



00:24

Sit To Stand



Bicep Curls



Calf Raises



Long term 5 year data

Supervised Exercise Therapy for Intermittent Claudication: A Propensity Score Matched Analysis of Retrospective Data on Long Term Cardiovascular Outcomes

Bharadhwaj Ravindhran  · Arthur J.M. Lim · Thomas Kurian · ... · Daniel Carradice · Ian C. Chetter · Sean Pymer... [Show more](#)

[Affiliations & Notes](#) ▾ [Article Info](#) ▾ [Linked Articles \(1\)](#) ▾



6MWT p 266 patient referred for SET. 64 completed SET. Those that completed SET were less likely to require revascularisation at 5 years.

Long term 5 year data

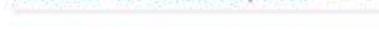
› Eur J Vasc Endovasc Surg. 2020 Dec;60(6):881-887. doi: 10.1016/j.ejvs.2020.07.074. Epub 2020 Sep

Successful Implementation of the Exercise First Approach for Intermittent Claudication in the Netherlands is Associated with Few Lower Limb Revascularisations

Sandra C P Ja
Joep A W Teij

Effects of Long-Term Home Exercise in Participants With Peripheral Artery Disease

Andrew W. Gardner, PhD



















































































































































































































































































































What do we need to know?

All data to date is from short term intervention

An app can provide long term intervention

- Does this help?
- What is compliance?

An app can be used to provide monitoring

- Frequency of use
- Engagement
- Uptake

Restart use if symptoms deteriorate

How to use Walk-A-Cise

Set-up on referral,
review data in
nurse-led clinic

Set-up on clinical
review –
SVN/secretary

Remote follow up

Patient Initiated
Follow up

Conclusion

- Exercise therapy is the first treatment option for PAD
- It should be used both before and after surgical intervention
- Provision of exercise therapy is poor
- Using tracking based technology enables
 - Greater access – removes postcode lottery
 - Longer term use
 - Green solution
- Alternative therapies are available but large trials are needed



Next Steps with Walk-A-Cise



Starting in multiple hospitals



Real World Use data



Clinical trials



Primary Care



- Isabelle Sanders
- Pavithira Sivagangan
- Mike Robinson



granite

NIHR

Cardiovascular
MedTech Co-operative



HEALTH &
SOCIAL CARE
PARTNERS



Eastern AHSN



VS PAD SIG



Norfolk and Norwich
University Hospitals
NHS Foundation Trust



Walk
A
Cise