NICE National Institute for Health and Care Excellence

NICE guidance

Targeted muscle reinnervation for managing limb amputation pain

HealthTech guidance
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Your responsibility

This guidance represents the view of NICE, arrived at after careful consideration of the evidence available. When exercising their judgement, healthcare professionals are expected to take this guidance fully into account, and specifically any special arrangements relating to the introduction of new interventional procedures. The guidance does not override the individual responsibility of healthcare professionals to make decisions appropriate to the circumstances of the individual patient, in consultation with the patient and/or guardian or carer.

All problems (adverse events) related to a medicine or medical device used for treatment or in a procedure should be reported to the Medicines and Healthcare products Regulatory Agency using the Yellow Card Scheme.

Commissioners and/or providers have a responsibility to implement the guidance, in their local context, in light of their duties to have due regard to the need to eliminate unlawful discrimination, advance equality of opportunity, and foster good relations. Nothing in this guidance should be interpreted in a way that would be inconsistent with compliance with those duties. Providers should ensure that governance structures are in place to review, authorise and monitor the introduction of new devices and procedures.

Commissioners and providers have a responsibility to promote an environmentally sustainable health and care system and should assess and reduce the environmental impact of implementing NICE recommendations wherever possible.

Contents

This guidance replaces IPG804.

1 Recommendations

Secondary procedure to treat problematic pain after limb amputation

1.1 Targeted muscle reinnervation can be used in the NHS, while more evidence is generated, as a secondary procedure to treat problematic pain that has developed after limb amputation. It can only be used with special arrangements for clinical governance, consent, and audit or research.

1.2 Clinicians wanting to do targeted muscle reinnervation to treat problematic pain that has developed after limb amputation should:

- Inform the clinical governance leads in their healthcare organisation.
- Ensure that people (and their families and carers as appropriate) understand the procedure's safety and efficacy, and any uncertainties about these.
- Take account of NICE's advice on shared decision making, including NICE's information for the public.
- Audit and review clinical outcomes of everyone having the procedure. The main efficacy and safety outcomes identified in this guidance can be entered into NICE's audit tool (for use at local discretion).
- Discuss the outcomes of the procedure during their annual appraisal to reflect, learn and improve.

1.3 Healthcare organisations should:

- Ensure systems are in place that support clinicians to collect and report data on outcomes and safety for everyone having this procedure.
- Regularly review data on outcomes and safety for this procedure.

1.4 Patient selection should be done by a multidisciplinary team, which could include a rehabilitation medicine consultant.

Primary procedure to prevent problematic pain after limb amputation

1.5 More research is needed on targeted muscle reinnervation before it can be used in the NHS as a primary procedure to prevent problematic pain from developing after limb amputation.

1.6 This procedure should only be done as part of a formal research study and a research ethics committee needs to have approved its use.

What research is needed

1.7 More research is needed on:

- patient selection
- details of the technique used
- the need for reintervention
- short- and long-term outcomes, including effects on pain and quality of life.

Why the committee made these recommendations

Evidence on this procedure shows it can reduce pain that has developed after limb amputation and there are no major safety concerns. But, there is a lack of high-quality evidence. The evidence includes procedures that were done at the same time as amputation to prevent pain from developing (primary procedure) and after amputation to treat pain (secondary procedure).

Pain that develops after amputation can be difficult to treat and can have a substantial impact on quality of life. So, this procedure can be used with special arrangements to treat

problematic pain that has developed after limb amputation.

It is unclear who would benefit from the procedure when it is done at the same time as amputation to prevent problematic pain. More evidence is needed on patient selection before the procedure is used in this situation.

2 The condition, current treatments, unmet need and procedure

The condition

2.1 A limb may need to be amputated for a variety of reasons, including peripheral vascular disease, infection, trauma and cancer. When the limb is amputated, nerves at the end of the residual limb are cut. This can cause 2 types of persisting limb pain: residual limb pain (often caused by nerve endings forming painful neuromas) or phantom limb pain felt in the removed part of the limb. Pain can persist for many years after the amputation. It can have a substantial effect on quality of life and it can be difficult to manage.

Current treatments

2.2 Medicines that may be used to help relieve persisting limb pain after amputation include:

- non-steroidal anti-inflammatory drugs such as ibuprofen or corticosteroid injections, which counteract inflammatory pain
- medicines that stabilise inappropriate nerve activity such as antiepileptics including pregabalin or gabapentin, and local anaesthetic injections
- antidepressants that are used to treat nerve pain such as amitriptyline or nortriptyline
- medicines that modulate the central response to pain awareness, including opioids such as codeine or morphine.

Other treatment options include spinal cord or peripheral nerve stimulation.

2.3 Surgical options for treating a painful neuroma include:

- removal of the damaged nervous tissue
- transposition of the neuroma away from the exposed painful region into a suitable tissue
- reconstruction of the damaged nerve to allow its axons to regenerate through nervous tissue to a sensory target organ, with the possibility to regain sensory input to the central nervous system.

Unmet need

2.4 Chronic pain after amputation is common and can be difficult to manage with medicine. It can be debilitating, with a negative impact on quality of life. It can also stop people from moving comfortably on their prosthetic limbs. Conventional surgical treatments for painful neuromas include excising and burying the nerve endings in muscle or other deep tissue. But, the neuroma can reform and the pain can often come back.

The procedure

2.5 Targeted muscle reinnervation (TMR) is a procedure that redirects nerves severed by amputation to new muscle targets. The aim is to reduce residual limb pain or phantom limb pain. It also aims to reduce chronic pain that has not responded to conventional treatments, without the risk of neuroma recurrence. The procedure can be done at the same time as the amputation, to prevent pain developing, or as a secondary procedure to treat pain that has developed after amputation.

2.6 The procedure is done under general or regional anaesthetic. There are 3 main steps:

- preparation of the donor nerve
- identification of a motor branch to the targeted muscle, and
- nerve coaptation.

The major mixed motor and sensory nerves proximal to the amputation site are identified. A nerve stimulator is used to show the motor and sensory nerve branches within, and these are traced distally towards the stump. Motor nerve branches that innervate muscles that are redundant after the amputation are identified and divided. The involved sensory nerves are then connected to these motor branches using 8-0 or 9-0 nylon sutures under magnification. It is thought that the nerve endings stop causing pain once they have found an alternative sensory organ within the muscle, because their physiology is restored.

2.7 Regenerative peripheral nerve interface is another technique that involves innervation of denervated muscle. The severed nerve is split lengthwise into its main fascicles, which are then implanted into free muscle grafts. It might be done instead of TMR if no suitable muscle target is available. It is sometimes done at the same time as TMR, if multiple nerves are involved.

3 Committee considerations

The evidence

3.1 NICE did a rapid review of the published literature on the efficacy and safety of this procedure. This comprised a comprehensive literature search and detailed review of the evidence from 13 sources, which was discussed by the committee. The evidence included 2 systematic reviews, 1 randomised controlled trial (also included in the systematic reviews), 1 retrospective propensity score-matched study, 2 prospective cohort studies, 1 prospective case series (also included in the systematic review) and 6 retrospective case series or cohort studies (1 of which was also included in the systematic review). It is presented in the summary of key evidence section in the overview. Other relevant literature is in the appendix of the overview.

3.2 The professional experts and the committee considered the key efficacy outcomes to be: reduction in pain and improved quality of life.

3.3 The professional experts and the committee considered the key safety outcomes to be: pain, bleeding, infection and reoperation.

3.4 Patient commentary was sought but none was received.

Committee comments

3.5 The committee was told that the procedure may have different benefits in upper and lower limbs. It may help use of a prosthesis in upper limbs.

3.6 The committee was told that the procedure may unmask a neuroma in another nerve and another operation may be needed.

3.7 The committee was told that this procedure should be done by surgeons experienced in nerve surgery.

Update information

Minor changes since publication

January 2026: Interventional procedures guidance 804 has been migrated to HealthTech guidance 750. The recommendations and accompanying content remain unchanged.

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Endorsing organisation

This guidance has been endorsed by Healthcare Improvement Scotland.