

Amputation

Introduction

An amputation is the surgical removal of part of the body, usually an arm or leg.

There are three main reasons why an amputation is carried out:

The limb has been affected by gangrene (when the body's tissue begins to die as a result of loss of blood supply)

The limb poses a life-threatening danger to the person's health, for example because it has been affected by cancer or a serious infection

The limb has experienced serious trauma, such as a crush or blast wound

How common are amputations?

The most common reason for amputation is a loss of blood supply to the affected limb (critical ischaemia), which accounts for 70% of lower limb amputations. Trauma is the most common reason for upper limb amputation, which accounts for 57%.

People with either type 1 diabetes or type 2 diabetes are particularly at risk and are 15 times more likely to need an amputation than the general population. This is because the high blood glucose levels in diabetes can damage blood vessels, leading to a restriction in blood supply.

More than half of all amputations are performed in people aged 70 or over and men are twice as likely to need an amputation as women.

Prosthetics

After the amputation, it may be possible to fit a prosthetic (artificial) limb onto the remaining stump. Prosthetic limbs have become increasingly sophisticated and can reproduce many functions of the hands, arms and legs.

For example, many people who have had the foot and lower section of the leg from beneath the knee removed (transtibial amputation) can walk or ride a bike using a prosthetic limb.

However, adjusting to life with a prosthetic limb requires an extensive course of physiotherapy and rehabilitation. Also, it takes a lot more physical energy to use a prosthetic limb as your body has to compensate for the missing muscle and bone. This is why frail people or those with a serious health condition, such as heart disease, may not be suitable for a prosthetic limb.

Outlook

The outlook for people with an amputation often depends on:
their age (younger people tend to cope better with the physical demands of adjusting to life with an amputation)
how much of the limb was removed (if less of the limb is removed, there will be a greater range of movement in the prosthetic limb)
how well they cope with the emotional and psychological impact of amputation

Many people who have had an amputation reported feeling emotions such as grief and bereavement, similar to experiencing the death of a loved one.

A phantom limb is also a common complication following an amputation. This is when a person experiences the sensation of their limb still being attached to their body, often causing pain.

Why amputation is necessary

The most common reasons for carrying out an amputation are gangrene, atherosclerosis (where the arteries become narrowed and hardened), infection or trauma, where there is a serious injury to a limb or part of a limb.

These, and other less common reasons, are explained in more detail below.

Gangrene from a diabetic foot ulcer

A diabetic foot ulcer is an open sore that develops on the feet of people with diabetes.

High blood sugar causes damage to the nerves (peripheral neuropathy) and the blood vessels, particularly in your feet.

Therefore, the reduced sensation of the nerves means you are more likely to develop an ulcer, and the reduced blood supply means the ulcer is more likely to become infected. The infection is likely to further restrict blood supply, leading to gangrene (decay and death of body tissues).

Once gangrene has developed, it is sometimes necessary to amputate the affected limb to prevent the spread of infection and further damage to healthy tissue.

Atherosclerosis

Atherosclerosis is a potentially serious condition that gets worse over time. The body's arteries become clogged by fatty substances such as cholesterol.

You are more likely to get atherosclerosis if you smoke, if you're obese or have high cholesterol or high blood pressure.

Many people with atherosclerosis go on to develop a condition called peripheral arterial disease, which occurs when there is a blockage in the arteries of your limbs (in most cases, your legs).

In most severe cases of peripheral arterial disease, the blood supply to the lower limbs can become blocked, leading to the development of gangrene, which may then require revascularisation (restoration or improvement of blood supply) or amputation.

Trauma

Amputation may be necessary if a limb has been severely injured.

Examples of injury include:

crush injuries, such as your arm or leg being severely crushed in a car crash

blast injuries, such as those experienced by soldiers wounded by explosive devices

avulsion injuries, where a body part is torn away from the body, such as a dog biting your finger off

guillotine injuries, where a limb or part of a limb is cut entirely or almost entirely away from the body, such as accidentally cutting off your thumb with a power saw
severe burns (including chemical burns)

Less common reasons

Less common reasons for amputation include:

cancers that develop inside the skin or bone of a limb, such as osteosarcoma (a type of bone cancer) or malignant melanoma (a type of skin cancer)

infections, such as an infection of the bone (osteomyelitis) or necrotising fasciitis (a serious type of bacterial skin infection sometimes referred to as flesh-eating bacteria)

Buerger's disease, a rare condition where blood vessels supplying the hands, arms, feet and legs become swollen and blocked, which can sometimes lead to gangrene and infection

How amputation is performed

There are two main types of amputation: lower limb amputation, where the foot and part of the leg are removed; and upper limb amputation, where the hand and part of the arm are removed.

An amputation can also be:

minor, where only a toe, finger or part of the foot or hand is removed

major, where a large part of the limb is removed

Lower limb amputations

The most common type of major amputation, accounting for more than half of all cases, is a type of lower limb amputation known as transtibial amputation. This is where the bottom section of a leg is amputated beneath the knee. A transtibial amputation is also known as a below-knee amputation.

Other types of lower limb amputation, are:

lower digit amputation, where one or more of the toes are amputated

transfemoral, where both the bottom half of the leg and part of the thigh above the knee are amputated, also known as an above-knee amputation
double lower amputation, where both legs are amputated, usually below the knee

knee disarticulation, where the amputation is performed through the middle of the knee joint

partial foot amputation, where the toes and lower half of the foot are amputated

hip disarticulation, where the amputation takes place through the hip joint, removing the entire leg

hemipelvectomy, where an entire leg and a section of the pelvis are amputated (a hemipelvectomy is the rarest type of lower limb amputation, usually only reserved for the most serious and extensive cases of damage to the limb)

Upper limb amputations

Most upper limb amputations are needed because the hand and arm have been damaged by a traumatic injury.

The main types of upper limb amputation, are:

upper digit amputation, where the thumb or one or more of the fingers are amputated

transhumeral, where the hand and a section of the arm are amputated above the elbow

transradial, where the hand and a section of the arm are amputated below the elbow

partial hand amputation, where a section of the hand is amputated

shoulder disarticulation, where the amputation occurs through the shoulder joint, removing the entire arm

double upper amputations, where both hands and some of the arms are amputated

forequarter amputation, where the entire arm is amputated along with a section of the shoulder blade and collar bone

wrist disarticulation, where the amputation occurs through the wrist joint, removing the hand

elbow disarticulation, where the amputation occurs through the elbow joint, removing the hand, wrist and forearm

Pre-operative assessment

Unless your amputation is performed as an emergency, you will probably go through a number of tests and procedures before the amputation takes place. These are designed to assess the type of amputation suitable for you and anything that may affect your rehabilitation.

These tests and procedures may include:

a thorough medical examination, including assessing your physical condition, nutritional status, bowel and bladder function and the various systems of your body, such as your cardiovascular system (heart, blood and blood vessels) and your respiratory system (lungs and airways)

an assessment of the condition and function of the healthy limb. Removing one limb can place extra strain on the remaining limb, so it is important to reduce any potential risk of amputation of the remaining limb at a later date

a psychological assessment to determine how well you will cope with the psychological and emotional impact of amputation and whether you will require additional support

an assessment of your home, work and social environments to determine whether any additional provisions will need to be made to help you cope

After the pre-operative assessment, the surgeon should be able to tell you the type of amputation you need.

You will also be introduced to a physiotherapist, who will be involved in your post-operative care and, if necessary, a prosthetist (a specialist in prosthetic limbs) who will tell you more about the type and function of prosthetic limbs (or other devices) available.

Things that will influence the type of prosthetic limb recommended for you include:

the type of amputation

the amount of muscle strength in the remaining section of the limb
your general state of health

tasks the prosthetic limb will be expected to perform, such as whether you have a desk or manual job and what type of hobbies you have
whether you want the limb to look as physically real as possible or whether you are more concerned with being able to use the limb for a wide range of activities

You may have to decide between having a prosthetic that is physically realistic or one that is functionally useful. However, it is possible to have a prosthetic limb that is both physically realistic and fully (or mostly) functional.

Many people planning to have an amputation find it both reassuring and useful to talk to somebody who has gone through a similar type of amputation. A member of your care team may be able to put you in touch with someone.

Surgery

An amputation is carried out under a general anaesthetic or an epidural anaesthetic, so you will feel no pain during surgery.

Ideally, as much of the limb as possible should be spared as this will mean you will have a greater range of movement and functional ability in your prosthetic limb.

A number of additional techniques can be used during surgery to help improve the remaining limb function and reduce the risk of complications. These include:

shortening and smoothing the bone in your remaining limb so it is covered by an adequate amount of soft tissue and muscle

stitching the remaining muscle to the bones to help strengthen your remaining limb

After the amputation, the remaining stump wound is sealed with stitches or staples.

Reattaching a limb

If part of the body is accidentally cut off during a guillotine injury, it is often possible to reattach (replant) the body part using surgery. However, the same is not usually true for crush or avulsion injuries, as the damage to surrounding tissue is usually too extensive.

If you or somebody you know has a guillotine injury that causes a body part to become completely detached:

immediately dial for an ambulance

while waiting for the ambulance, clean the wound with water

try to stem the bleeding by covering the wound with a pressure bandage

take the detached body part and cover it in sterile gauze, if available

place the body part in a resealable plastic bag or waterproof container

surround the container or bag with ice

Do not place the body part in direct contact with ice as this could damage the tissue.

Digits, such as fingers and toes, can survive for up to eight hours if properly stored and chilled. Extremities, such as hands, arms, feet and legs, can survive for up to six hours.

Replantation of the body part involves reattaching the various muscle groups, nerves, tendons and blood vessels.

The success rate for replantation surgery is around 80%.

However, replanting a body part may not always be recommended. For example, replanting the feet and legs is not usually recommended as most people will function better with prosthetic limbs than reattached limbs.

Recovering from an amputation

After surgery, you will be transferred back to a ward. You will normally be given oxygen through a mask and nutrients and fluids through a drip for the first few days after surgery.

Your amputation wound will be covered with a bandage or plaster dressing and a tube may be placed under the skin next to the wound to drain away any excess fluid from the site of the surgery. This will help prevent excessive bruising and swelling at the wound. It is usually recommended that the bandage remains in place for the first five days to reduce the risk of infection.

A small flexible tube, known as an urinary catheter, may be placed in your bladder during your surgery to drain away urine. This means you will not need to worry about going to the toilet for the first few days after surgery.

It is likely that you will experience considerable pain at the site of the operation, so painkillers will be supplied as required. Let your pain nurse know if the painkillers are not working as you may need a larger dose or a stronger type of painkiller.

Preparing for discharge

As you gradually recover from the effects of surgery, you will meet a number of different health professionals, such as a social worker, occupational therapist and physiotherapist, to help plan for your discharge.

Your physiotherapist will also teach you a number of exercises to help prevent blood clots and improve blood supply.

Compression shrinker sock

You will notice swelling (oedema) of your stump after surgery, which is normal. This swelling can also continue once you have been discharged.

Using a compression shrinker sock will help with swelling and the shape of the stump. It may also reduce phantom pain and give a feeling of support to the limb.

Your physiotherapist will measure you for your sock once your wound has healed and the sock can be placed over your stitches.

The sock should be worn every day, but taken off before you go to bed. It is important to wash the sock regularly (every 2-3 days) and you should be supplied with at least two socks.

Going home

How long it will take before you are ready to go home will depend on the type of amputation you have and your general state of health.

In many parts of the country it is common to be transferred to another hospital or ward for a period of rehabilitation following a leg

amputation. This is usually done when you no longer require the facilities of the surgical ward.

It can take several months before you are fitted with a prosthetic limb, or a prosthetic limb may not be suitable for you (see below for more information on prosthetics), so you may be given a wheelchair if you had a lower limb amputation.

Also, a dietitian can advise on changes you can make to your diet to cope with the extra energy requirements you may have if using a prosthetic limb.

You will probably be asked to attend a follow-up appointment two weeks after leaving hospital to discuss how well you are coping at home and whether you require additional help, support or equipment.

You may also be given details of your nearest amputee support group, made up of both health professionals and people living with an amputation.

Fitting the prosthetic

A prosthetic limb is not suitable for everyone, especially a lower prosthetic limb. Using a prosthetic limb takes a considerable amount of energy because you have to compensate for loss of muscle and bone in the amputated limb.

For example, a person fitted with a prosthetic limb after a transfemoral (above-knee) amputation has to use 80% more energy to walk than a person with two legs. So if it is thought your body would not withstand the strain of using a prosthetic limb – for example, if you had a heart condition – then a purely cosmetic limb may be recommended instead (a limb that looks like a real limb but cannot be used).

If you are a suitable candidate for a prosthetic limb, you will begin a programme of activities while still in hospital to prepare for the prosthetic.

Before a prosthetic is fitted, the skin covering your stump may be made less sensitive (known as desensitisation). This will make the prosthetic more comfortable to wear.

Skin desensitisation consists of the following steps:
gently tapping the skin with a face cloth

using compression bandages to help reduce swelling and prevent a build-up of fluid inside and around your stump
rubbing and pulling the skin around your bone to prevent excessive scarring

Your physiotherapist will teach you a range of exercises designed to strengthen muscles in the remainder of your limb while also improving your general energy levels, so you can cope better with the demands of an artificial limb.

Depending on the level of provision in your local primary care trust, it can take several months before you get your first appointment with a prosthetist (specialist in prosthetic limbs).

Lower limb prosthetic

There is a large range of lower limb prosthetics. Most lower limb prosthetics consist of the components listed below:

The socket is the interface between your prosthetic limb and the remainder of your real limb. The most common type of socket used in lower limb prosthetics is known as a patellar tendon-bearing socket, which is a plaster mould designed to fit around the knee joint

A suspension system keeps the prosthetic limb in place. Examples of suspension systems include strapping systems and suction cups

Artificial joints are a type of metal hinge designed to replicate the function and range of movement of real joints, such as the knee or ankle joints

A pylon is a metal rod designed to replicate the function of the main bones of the leg

A prosthetic foot is made from metal, plastic or a combination of both and is designed to replicate the main functions of the real foot, such as bearing the weight of the limb and aiding balance and stability

Upper limb prosthetics

Again, there is a wide range of upper limb prosthetics, which generally consist of the components listed below.

The socket is usually made from lightweight plastic or graphite (a type of lightweight mineral) designed to fit around the remaining limb, which in most cases is a section of the arm just below the elbow joint

A suspension system, either a strapping or suction system, keeps the limb in place

A control mechanism is designed to replicate the movements of the arm and hand. One commonly used type of control system is to attach cables to muscles in other parts of your body, such as your shoulder or upper arm. You learn a range of movements that allow you to control the prosthetic limb. Alternatively, the control mechanism can be electric and controlled by electrodes implanted in your arm, which respond to the electrical activity generated by certain muscles

A terminal device serves as the 'hand' of the prosthetic limb. Terminal devices have tended to either be physically realistic and cosmetically pleasing but with little practical function, or look very artificial (such as a hook or a claw) but with a wide range of potential functions. More sophisticated terminal devices are now being developed that are both cosmetically pleasing and functional

Stump care

It is important to keep the skin on the surface of your stump clean to reduce the risk of the skin becoming irritated or infected.

Wash your stump at least once a day (more frequently in hot weather) with a mild antibacterial soap and warm water, and dry it carefully.

If you regularly take baths, do not leave your stump submerged in water for long periods of time. This is because the water will soften the skin on the stump, making it more vulnerable to injury.

Using unmedicated talcum powder, such as baby talcum powder, is an effective way to help reduce perspiration (sweat) around your stump.

Some people find wearing one or more socks around their stump can also help absorb perspiration and reduce skin irritation. As the size of the stump may change during recovery as swelling goes down, the number of socks used may vary. However, it is important to change the socks every day to maintain a hygienic environment.

If you have a prosthetic limb, clean the socket regularly with soap and warm water.

Check your stump carefully every day for any sign of infection such as:

warm, red and tender skin

discharge of fluid or pus

swelling of the skin

If you think you may be developing a skin infection, contact your care team for advice.

Care of your remaining limb

After losing a leg, it is very important to avoid injury and damage to your remaining 'good' leg, particularly if you are diabetic, as the conditions that led to the need for amputation may also be present in the remaining leg.

You should ensure that you avoid poorly fitting footwear, and that an appropriately trained individual (such as a chiropodist) is involved in nail care and other aspects of the care of your remaining foot.

Using your prosthetic hand to grip

The most important function a terminal device should be able to replicate is the ability to grip.

Ideally, a terminal device should be able to reproduce the five main types of grip, which are:

precision grip, where the thumb and index finger join together to pick up a small object such as a bead

tripod grip, where the thumb, index finger and middle finger come together, such as when holding a chopstick

lateral grip, when the thumb and index finger come together to manipulate an object, such as turning a key in a lock

hook power grip, when the fingers and thumb hook round an object, such as holding a bag by its handle

spherical grip, when the tips of the fingers and thumb come together in a flexing motion, such as opening a doorknob

Complications of amputation

There are a number of factors that influence the risk of complications from amputation, such as your age, the type of amputation and your general state of health.

The risk of serious complications is higher in planned amputations than in emergency amputations.

This is because most planned amputations involve the leg and are carried out in older people with a restricted blood supply, who are in a poor state of health and who usually have a chronic (long-term) health condition, such as diabetes. Most emergency amputations involve the arm and are usually carried out in younger people who are often in a good state of health.

Complications from amputation include:

heart complications, such as heart attack or heart failure (when the heart has difficulty pumping blood around the body)

blood clots (venous thrombosis)

infection at the site of the surgery

pneumonia (infection of the lungs)

further surgery being required

Due to the relatively high risk of complications, a planned amputation is seen as a 'treatment of last resort'. It is only used when there is no other way of preventing life-threatening and serious symptoms, such as gangrene, from developing.

Phantom limb pain

Phantom limb pain is when a person experiences sensations of pain that seem to be coming from the limb that has been amputated.

It is estimated that 50-80% of people develop phantom limb pain after an amputation. The condition is more common in women than men.

Phantom limb pain also appears to be more widespread in people who have had an upper limb amputation than in people who have had a lower limb amputation.

The term 'phantom' does not mean that the symptoms of pain are imaginary and all in your head. Phantom limb pain is a very real phenomenon which has been confirmed using brain imaging scans to study how nerve signals are transmitted to the brain.

The symptoms of phantom limb pain can range from mild to severe. Some people have described brief 'flashes' of mild pain, similar to an electric shock, that last for a few seconds. Other people have described constant severe pain.

The causes of phantom limb pain are unclear. There are three main theories:

The peripheral theory argues that phantom limb pain may be the result of nerve endings around the stump forming into little clusters, known as neuromas. These may generate abnormal electrical impulses that the brain interprets as pain

The spinal theory suggests that the lack of sensory input from the amputated limb causes chemical changes in the central nervous system. This leads to 'confusion' in certain regions of the brain, triggering symptoms of pain

The central theory proposes that the brain has a 'memory' of the amputated limb and its associated nerve signals. Therefore, the symptoms of pain are due to the brain trying to recreate this memory but failing because it is not receiving the feedback it was expecting

Treating phantom limb pain

It can be difficult to treat phantom limb pain as the effectiveness of every treatment varies between different people. Several types of treatment may need to be tested.

Medications

Medication which may be prescribed by your doctor to help relieve pain from nerve damage or to attempt to block pain signals include:

anticonvulsants – such as carbamazepine or gabapentin

antidepressants – such as amitriptyline or nortriptyline

opioids – such as codeine or morphine

Noninvasive therapy

There are several non-invasive techniques which may help relieve phantom limb pain in some people. They include:

applying heat or cold – such as using heat or ice packs, rubs and creams
massage – to increase circulation and stimulate muscles

acupuncture – needles inserted into the skin at specific points on the body thought to stimulate the nervous system and relieve pain

transcutaneous electrical nerve stimulation (TENS) – involves using a small electric device connected to a series of electrodes. The electrodes deliver small electrical impulses to the site of your stump. TENS is thought to work by disrupting the passage of pain signals to the brain and stimulating the release of natural painkilling chemicals known as endorphins

Mental imagery

Research carried out in Liverpool in 2008 found that if people spent 40 minutes imagining using their phantom limb, such as stretching out their 'fingers' or bunching up their 'toes', they experienced a reduction in pain symptoms.

This may be related to the central theory of phantom limb pain (that the brain is looking to receive feedback from the amputated limb) and these mental exercises may provide an effective substitution for this missing feedback.

One technique that can be used is known as mirror visual feedback. This is where a mirror is used to create a reflection of the other limb. Some people find that by doing exercises and moving their other limb it can help to relieve pain from a phantom limb.

Psychological impact of amputation

Loss of a limb can have a considerable psychological impact. Many people who have had an amputation report feeling emotions such as grief and bereavement, similar to experiencing the death of a loved one.

Coming to terms with the psychological impact of an amputation is therefore often as important as coping with the physical demands.

Having an amputation can have an intense psychological impact for three main reasons:

You have to cope with the loss of sensation from your amputated limb

You have to cope with the loss of function from your amputated limb

Your sense of body image, and other people's perception of your body image, has changed

It is common to experience negative thoughts and emotions after an amputation. This is especially true in people who had an emergency amputation, as they did not have time to mentally prepare themselves for the effects of surgery.

Common negative emotions and thoughts experienced by people after an amputation include:

depression

anxiety

denial (refusing to accept they need to make changes, such as having physiotherapy, to adapt to life with an amputation)

grief (a profound sense of loss and bereavement)

feeling suicidal

Talk to your care team about your thoughts and feelings, especially if you are feeling depressed or suicidal. You may require additional treatment, such as antidepressants or counselling, to improve your ability to cope with living with an amputation.

People who have had an amputation due to trauma (especially members of the armed forces injured while serving in Iraq or Afghanistan) have an increased risk of developing post-traumatic stress disorder (PTSD).

PTSD is when a person experiences a number of unpleasant symptoms after a traumatic event, such as 'reliving' the event and feeling anxious all the time.